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Skyways

Flight Operations • Engineering • Management

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Table: Role
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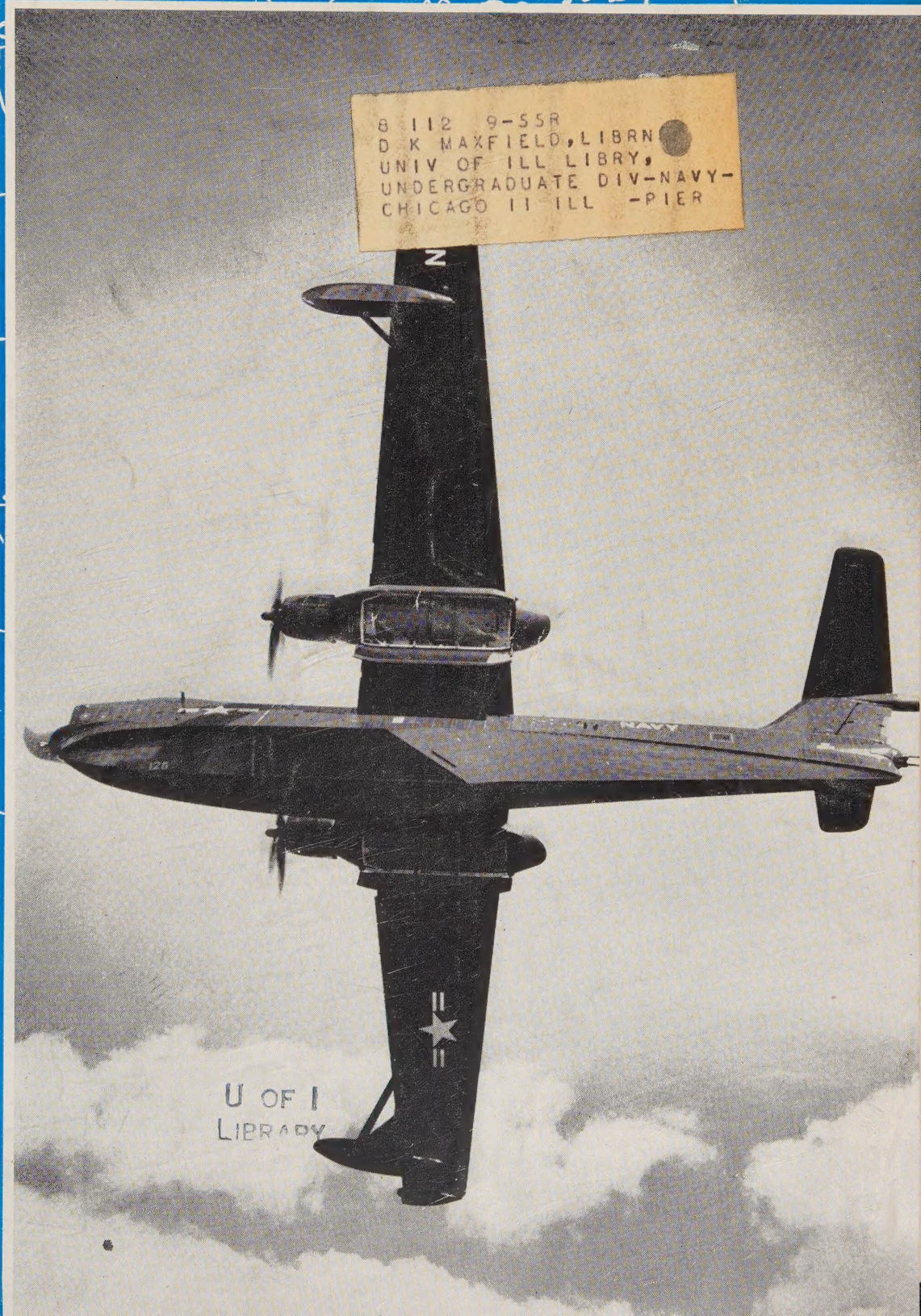

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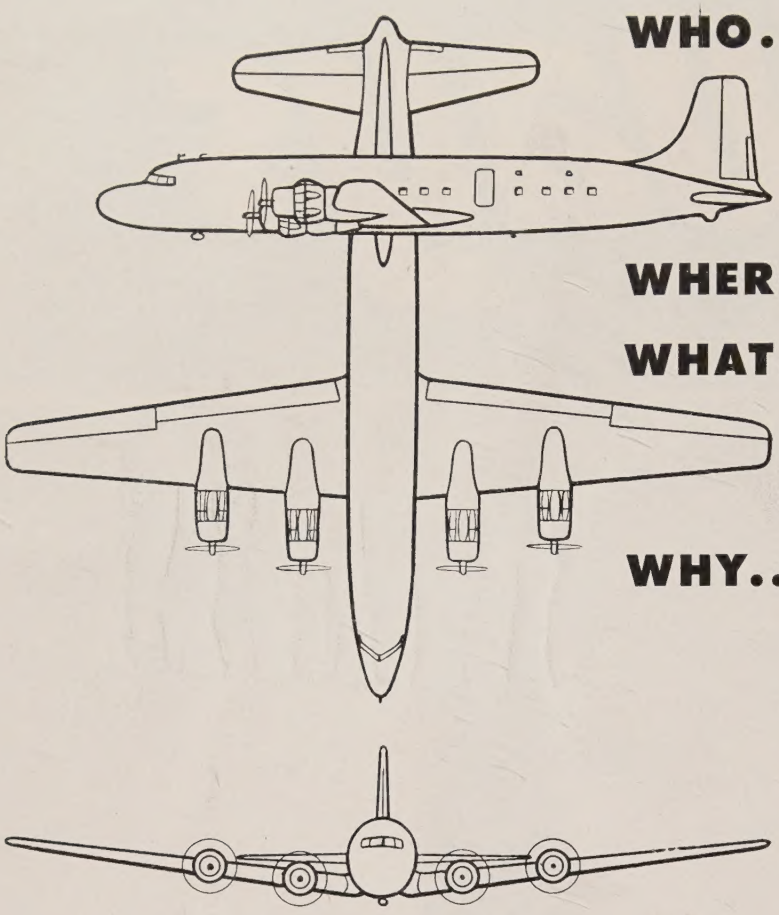

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WHERE... *Toledo, Ohio, U. S. A.*

WHAT... *10th Annual Champion Aircraft Spark Plug and Ignition Conference*

WHY... *Better, Safer Flying For You!*

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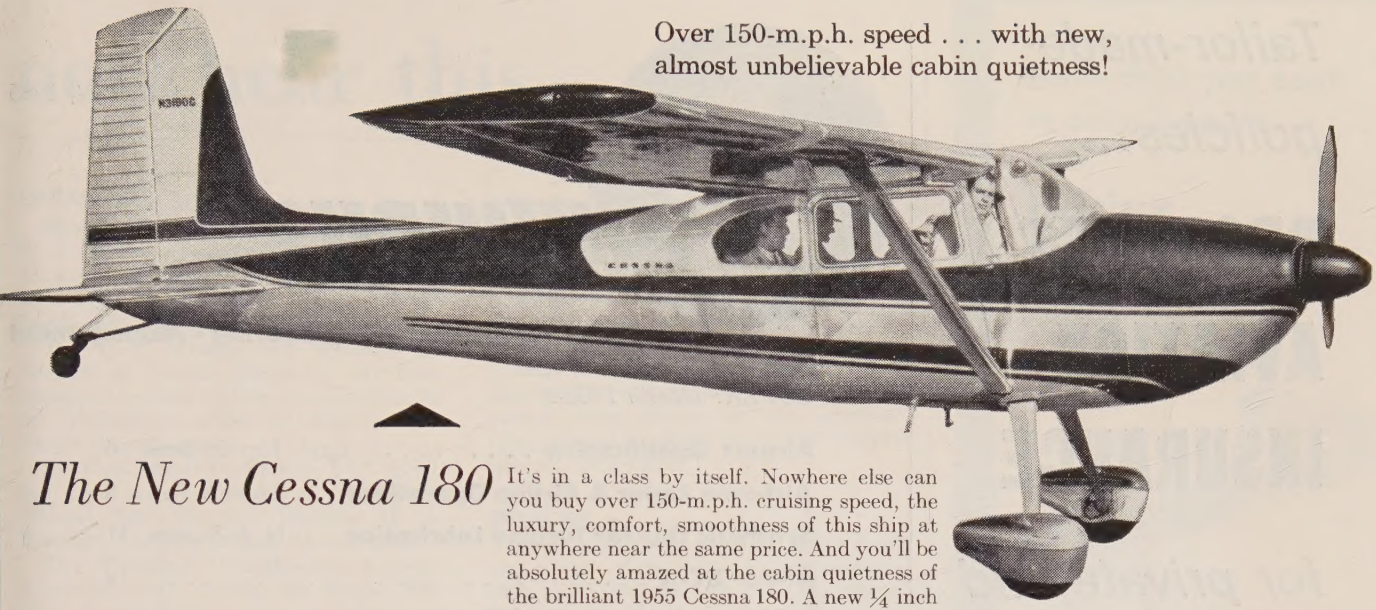

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JANUARY, 1955

Skyways

Flight Operations • Engineering • Management

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now hear this . . .

PERSONNEL

Morris M. Townsend of Short Hills, N. J. recently was elected a director of Vitro Corporation of America. Mr. Townsend replaces William B. Paul of Pittsburgh, who resigned.

Dr. T. P. Wright, vice president for research at Cornell University, has been appointed professor of air transportation in the University's school of Business and Public Administration.

Lt. Gen. Doyle O. Hickey, USA (Ret) has been named director of Continental Motors' New Products Division. **H. J. Buttner** has been named its manager.

Dr. Theodore Theodorsen, formerly a scientist with ARDC, has joined Fairchild Engine Division as a consultant.

C. Hart Miller recently was named executive assistant to Vice President John W. Myers of Northrop Aircraft, Inc.

George A. Page, Jr., former director of engineering for Aeronca Mfg. Corp., has been elected vice president in charge of research and engineering for the firm.

R. W. Richardson recently was named vice president in charge of sales for Goodyear Aircraft Corp. Mr. Richardson formerly was manager of Goodyear Tire and Rubber Company's north central division at Chicago.

W. Tom Neal has been elected vice president and director of overhaul and modification of Aero Corporation.

Frank J. Macklin has been appointed executive secretary of the Air Traffic Conference of America of the Air Transport Association. Mr. Macklin is also assistant vice president—traffic of ATA, and director of the Military Bureau.

Randall H. Carpenter, former American Airlines captain, has been appointed manager of the Air Transport Division of Flight Safety Foundation.

Leonard D. Sullivan has been named vice president in charge of sales of the Babb Co., Inc., and its subsidiaries.

Arthur J. Fallon recently was appointed Senior Air Terminal Properties representative in the Aviation Department of The Port of New York Authority. He will handle negotiations with airlines and other aviation tenants at LaGuardia, N. Y. Int'l, Newark and Teterboro Airports.

Louis Achitoff has joined Flight Safety, Inc., as assistant to the president, Al Ueltschi. Mr. Achitoff is an aeronautical engineer and holds an Air Transport Rating, DC-3, DC-4, Martin 202 & 404.

Ralph S. Lehman has been promoted to assistant to the commercial sales manager of LearCal Division of Lear, Inc. **Edwin J. Nilsson** has been named Eastern sales manager, Mr. Lehman's former position.

Thomas J. Kirkup was appointed general traffic and sales manager for Mohawk Airlines.

Kermit F. Wasmuth has been appointed director of quality control for Republic Aviation Corp.

J. N. Eustis has been made director of All American Engineering Company's Georgetown Test Base.

George R. Dutton has joined L. B. Smith Aircraft Corporation as manager, manufacturing control materials.

Edward J. Murphy has been appointed passenger sales manager for KLM in the New York Region.

Maj. Gen. Gordon A. Blake, USAF director of communications, has been appointed representative on the Executive Committee of the Radio Technical Commission for Aeronautics.

HONORS

Guy M. Miller, owner of Miller Aviation Center, Pittsburgh, was elected president of the National Air Taxi Conference. **Edward D. Morris** is the new 1st vice president, and **Frank W. Mayock,** 2nd vice president. **William J. Lotzer** and **Norman Larson** were reelected as representatives on the Executive Committee.

Kenneth A. Norton, Chief of NBS Radio Propagation Engineering Division, was awarded the Franklin Institute's Stuart Ballantine Medal for his work in radio research.

Capt. H. A. Gurney has been named for top honors in the 1953-54 Outstanding Performance Program for Flight Operations employees of United Air Lines. **Capt. Geo. W. Henderson** and **F. J. Todd,** supt. of aircraft radio, tied for runner-up award.

Edward L. "Swanee" Taylor, veteran pilot and aviation writer, has been given the Diploma of Honor of the International League of Aviators.

COMPANIES

Olin Mathieson Corp. has acquired a substantial interest in Marquardt Aircraft Company, Van Nuys, Calif. Mr. Laurance S. Rockefeller continues as one of Marquardt's principal stockholders.

Lund Aviation, Inc., New York City, has announced the formation of a Canadian affiliate known as Lund Aviation (Canada) Ltd. Offices are adjacent to Montreal Airport, Dorval, Quebec.

Daystrom, Inc. has announced an agreement to purchase the American Gyro Corporation, Santa Monica, Calif., manufacturers of gyroscopes for guided missiles, radar and aircraft. Daystrom has two electronic operations of its own and controls about 50% of the stock of the Weston Electrical Instrument Corp.

AERO CALENDAR

Jan. 19-23—Miami International Aerorama. Miami International Airport.

Jan. 24-27—American Meteorological Society national meeting, New York.

Jan. 24-28—IAS 23rd Annual Meeting and Honors Night Dinner, Hotel Astor, New York.

Mar. 11—IAS, National Flight Propulsion Meeting (restricted), Hotel Carter, Cleveland, Ohio.

Apr. 18-21—SAE Golden Anniversary Aeronautics Meeting, Aeronautic Production Forum and Aircraft Engr. Display, Hotels Statler and McAlpin, New York.

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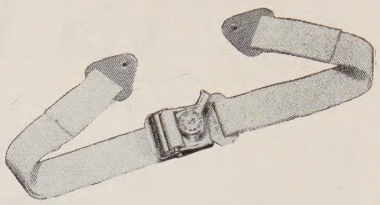

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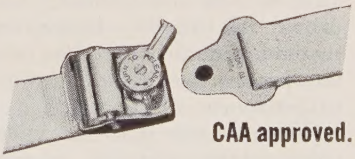

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by Capt. Kimball J. Scribner
Chief Pilot, Atlantic Division
Pan American World Airways

Airport Qualification via WIDE-SCREEN FILM

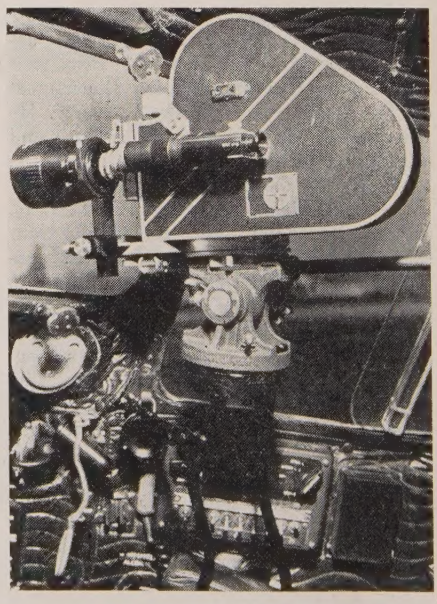
FIRST *photograph of the camera installation used by Pan American World Airways in the preparation of wide-screen color motion pictures for use in qualifying pilots into regular, provisional, refueling and alternate airports. Harry Coleman is shown testing the all-seeing eye of the anamorphic lens of the camera prior to take-off at LaGuardia. The New York airport was the first filmed by PAA in its program of adapting the Cinemascope color projection principle to the job of improving pilot airport qualification*

The Cinemascope principle of wide-screen color projection, which makes possible those big, breath-taking close-ups at the neighborhood theater, is the medium through which the world's scheduled airlines can revolutionize and improve the costly, time-consuming method of qualifying pilots into regular, provisional, refueling and alternate airports.

This new use of 16 mm wide-scope color motion pictures, accompanied by oral briefing on the sound track, has been under development by Pan American World Airways for more than a year. On the basis of our initial success, the Civil Aeronautics Board has been formally requested to modify its regulations to permit air carriers to adapt the film technique to their airport qualification operations. It is another conspicuous "first" in a long line of notable Pan Am contributions to aviation safety and dependability.

Specifically, PAA has applied for modification or re-interpretation of CAR Part 41.50 (c) to enable airlines to use the film qualification method *in lieu* of the current requirement under which actual approaches must be made into regular, provisional and refueling airports under supervision of a check pilot.

This medium of qualification is not designed to change in any way the current methods of insuring and checking a pilot's flying proficiency and ability to make instrument approaches or to be route qualified. Rather, the use of wide-scope color and sound projection is recommended solely to satisfy the "visual reference" requirements of the CAR as far as airport familiarization is concerned and, at the same time, to provide more adequate airport qualification of pilots than is sometimes possible



CLOSE-UP *of 16mm Cinekodak Special camera with Bell & Howell lens in position*

by an actual flight into an airport.

For years air carriers have been plagued by the nettlesome problem of finding an acceptable compromise between the desire for full airport qualification of pilots and the impracticability of requiring physical entry into all airports served. They have been concerned, too, with the mounting cost of maintaining pilot airport qualification.

The need for an improved system of airport qualification is underscored by the fact that the present regulation governing "visual reference" is inadequate from the standpoint of completely effective qualification. Only one actual passing approach to a regular, provisional or refueling airport, regardless of visibility conditions, night, rain or traffic, legally constitutes qualification into an airport for a pilot when he is accompanied by a check pilot. He, therefore, meets CAR requirements, although he may see only the approach lights and the runway on which he lands.

It is obvious that only one qualifying pilot at a time can have good visual reference to an airport during the approach, when accompanied by a check pilot. As many as 10 additional qualifying pilots aboard the aircraft may become legally qualified into the airport by merely looking out of various windows while attempting to listen to the check pilot's running description of the airport's physical features.

The drawbacks are apparent. Traffic around the airport, radio clearances and pre-landing check lists distract the check pilot and the qualifying pilots. Haze or cloud conditions reduce the effectiveness of the visual approach because qualifying pilots cannot see obstructions and terrain even if they are being described by the check pilot. The use of earphones is still another hindrance. Last but by no means least, because of the speed of the aircraft, the cost of its operation and the loss of pilot utilization, only the minimum approach to an airport is given during the qualification flight.

Pan American believes that far more effective airport qualification can be obtained and better visual reference to airports achieved through the use of color motion pictures accompanied by a carefully prepared recorded briefing. Such a procedure would have these advantages:

(1) Motion pictures would be taken in color from an airplane on a bright, clear day.

(2) The pictures would involve various approaches to the airport, including: (a) Approach from the outer marker along the instrument glide path; (b) a circling approach made from circling minimums; (c) panoramic views of the airport to show obstructions, their heights and positions relative to runways; (d) an accompanying voice description of the briefing required for any pilot qualifying into an airport.

Here's what the wide-scope film method would accomplish:

It would permit any number of pilots, seated comfortably in a briefing room, to view the same visual approach as that seen from the cockpit. The accompanying sound track would provide complete, detailed descriptions of obstructions, terrain, landing patterns, holding procedures and holding points and their identifications. Complete and undivided attention would be given to the color pictures and description of the airport without interference from other aircraft. The film would be shown at every periodic instrument check (six months) and could be repeated to insure complete familiarization with the airport. The tangible results would include more efficient scheduling and operation of flights, reduction in the cost of training, increased payloads and greater satisfaction among passengers. It also would assist immeasurably in the noise abatement program.

In addition to the film, three-dimensional drawings, still photographs and animated sketches can be utilized to insure complete, clear and detailed briefings at airport qualification sessions.

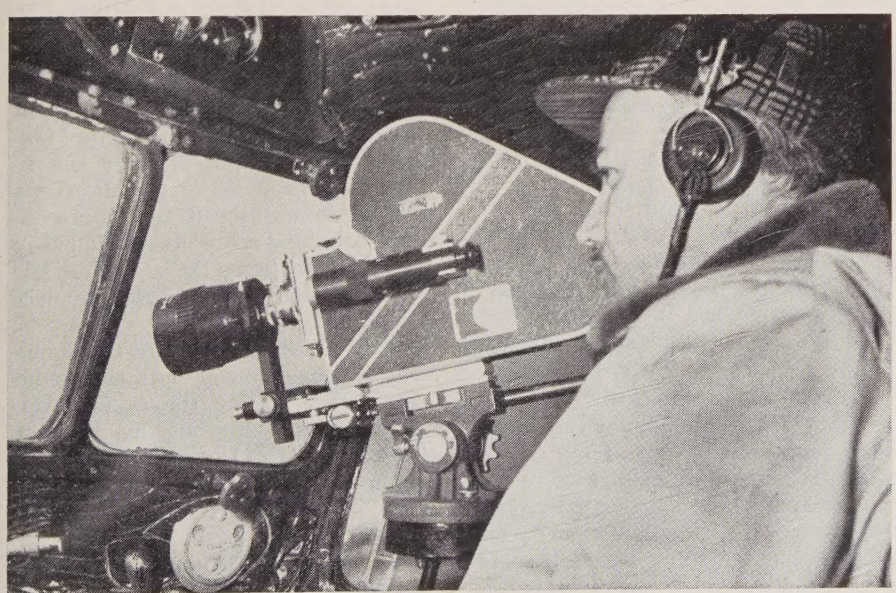
Pan American has completed a qualification film of LaGuardia Airport, using the Cinemascope wide-screen projection, and it has been shown before CAA, CAB, ATA, ALPA, Military Air Transport Service, National Air Transport Coordinating Committee, Port of New York Authority, many members of Senate and House committees, and other interested organizations. Tremendous interest has been generated in the film and, to use a theatrical expression, our notices have been uniformly good.

We used a Cinekodak Special 16 mm camera, equipped with an electric motor, and mounted it in position with the lens at the pilot's eye-level. The camera has an optical view finder corrected to take in the field of a Bell & Howell anamorphic lens. The pane of glass in the windshield in front of the camera is always removed to enable the photographer, Harry L. Coleman of Coleman Productions, to obtain sharp prints. The film magazine holds 200 ft of film.

We can't show you the film but with the camera installed at the pilot's eye-level in a DC-3, and the weather sharp and clear, here's what the running commentary of the check pilot is like as you sit and watch the qualification movie of LaGuardia Airport:

"To the right you will see that Riker's Island is a visual aid as we utilize either the southwest course of the LaGuardia range station or the back course localizer of the LaGuardia ILS for Runway 22 alignment. To keep yourself orientated, please refer to the LaGuardia Limited Visibility Approach Chart whenever you want to check your position rela-

(*Continued on page 48*)



SHOOTING *an approach to Runway 22 at LaGuardia Airport. Coleman mounts the camera at pilot's eye-level for the best results. Captain Scribner describes what the camera sees*

Application of
Airborne Radar to Airline Operations

FIG. 1—*RCA experimental 5.5-cm radar was installed in United Air Lines' DC-3 called "Sir Echo." Radome was installed by Douglas, equipment by UAL's San Francisco base*

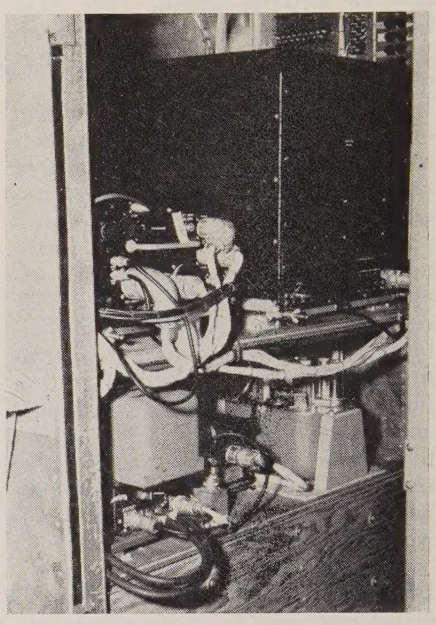


FIG. 2—*The transmitter-receiver unit, synchronizer, etc., were installed in baggage pit*

In October, 1953, United Air Lines had just completed its technical and operational evaluation of a 5.5-cm airborne weather radar. Members of the flight evaluation team were busy putting together a summary story for presentation before United's Flight Operations management on what a radar of this wavelength, designed primarily for weather mapping, would do for airline operations. On March 1, 1954 a detailed report titled "Evaluation of C-Band (5.5 cm) Airborne Weather Radar" was released covering the flight tests of this radar.

Since some of you, no doubt, have been asking yourselves the question "Why did United Air Lines evaluate a 5.5-cm radar?", let me take time at this point to give you the two-fold answer as I see it:

First of all, this evaluation program is typical of the independent development and research programs carried on from time to time by United and other scheduled airlines; programs which in general are designed to obtain solutions to specific problems facing a given air carrier or more often the industry as a whole.

Secondly, with theoretical studies and operational tests of 3- and 10-cm radars indicating that for weather mapping a wavelength somewhere in between would come closer to fulfilling airline weather-mapping radar requirements, United decided it was high time an actual evaluation was made to determine what a radar designed primarily for weather mapping and operating on 5.5 cm would do for airline operations. Before embarking on a multi-million dollar installation program, we wanted to know if such a radar would permit a pilot to avoid moderate and heavier turbulence, damaging hail, and tornadoes by detouring the hard cores of thunderstorms with small deviations from the flight-planned route rather than by wide detours of the entire storm area, and in this process permit the pilot to see through heavy rain so that he would not be led blindly into the hard core of a storm.

Aircraft Installation

The RCA experimental 5.5-cm radar, contracted for in October, 1952, was installed in a United DC-3 Cargoliner, which was nicknamed and fondly referred to as "Sir Echo." (*Fig. 1*). The radome was installed by Douglas Aircraft Company and the equipment mountings, wiring, wave guide, etc. were installed by United's San Francisco Maintenance Base. The transmitter-receiver unit, synchronizer and NACA and Ryan gust recorders were installed in the left baggage pit (*Fig. 2*).

The NACA VGH recorder provided a record on photo-sensitive paper of vertical acceleration, pressure altitude, airspeed, and time and event marks. Since the photographic record from this recorder had to be developed and analyzed by NACA, a Ryan recorder also was installed to provide on aluminum foil an immediately available record of acceleration, altitude, airspeed and time and event marks for use in debriefing sessions.

The radar operator's position was located in the left forward corner of the cabin (*Fig. 3*). A radar camera and periscope were installed on the radar observer's scope to permit simultaneous viewing and picture taking. A complete set of flight instruments was provided at the observer's position in addition to the radar controls. A second scope was installed in the cockpit between the two pilots and was equipped with a three-eyepiece viewer (*Fig. 4*).

Both radar scopes were the standard 5-inch diameter military radar type and presented the radar information as the familiar Plan Position Indication (PPI) display (*Fig. 5*). In an airborne PPI display, the aircraft is thought of as being at the center of the scope, as shown in *Fig. 5*, with the antenna cutting horizontal 7½° wedge-shaped slices out of the clouds it sweeps through (*Fig. 6*). The farther away the storm

UAL evaluation of airborne radar proves its use will contribute to passenger safety; provide crews with a new "tranquility of spirit"

by Edgar A. Post

Supt. of Navigational Aids
United Air Lines

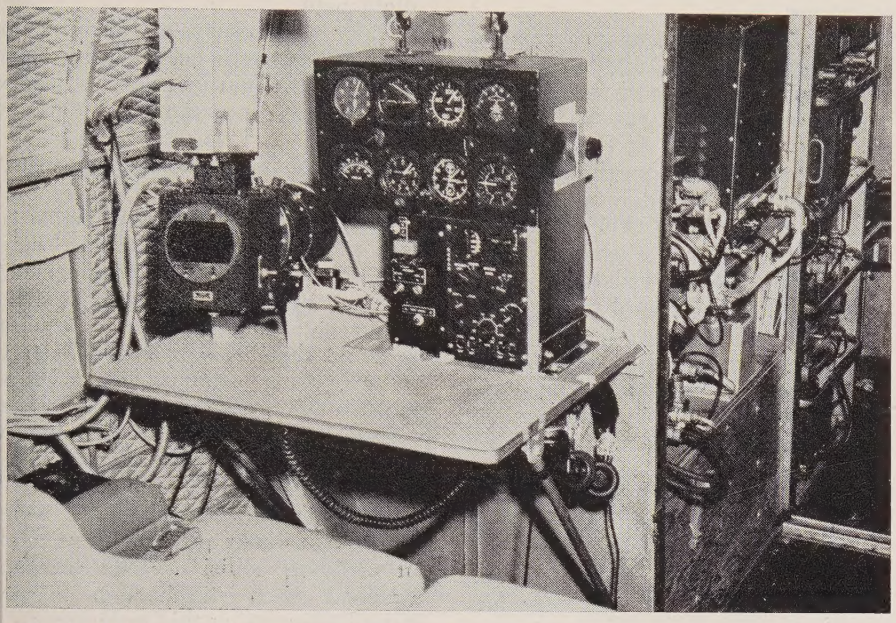


FIG. 3—*Radar operator's position was located in left forward corner of cabin. A complete set of flight instruments was installed at observer's position in addition to the radar controls*

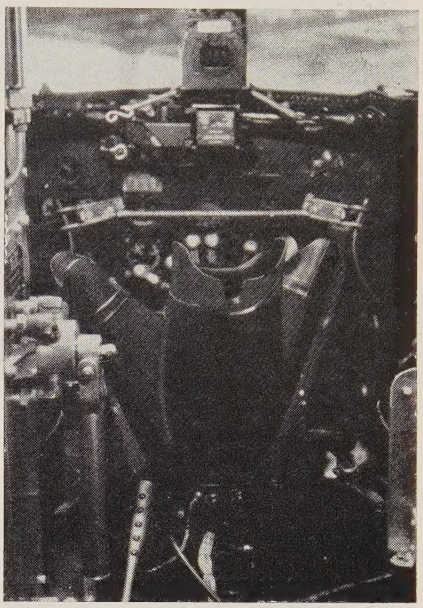


FIG. 4—*A second radarscope, with three-piece viewer, was installed between pilots*

is, the thicker the slice seen by the radar. Three antenna beams are shown in *Fig. 6* to indicate that antenna tilt permits the pilot to select the 7½° slice of the storm he wishes to examine.

The antenna installation in the nose of our DC-3 permitted echoes to be seen only in the area 125° on either side of straight ahead. The concentric circles in *Fig. 5* are range marks spaced two miles apart. Aircraft movement is always *toward* the top of the scope, therefore the radar echoes move from the top of the scope toward the bottom while the aircraft is maintaining a constant heading. It has become common practice to refer to the position of radar echoes as "pips" and to identify them in terms of a distance from the center of the display and a clock position. Utilizing this procedure, the cloud echo in *Fig. 5* would be referred to as being at 6 to 10 miles centered at 12:30 o'clock.

The RCA experimental radar had three ranges (*Fig. 7*) ; a 10-mile range with 2-mile range marks, a 30-mile range with 5-mile range marks, and a 100-mile range with 25-mile range marks. It will be noted that the 11:30 o'clock echo at 10 miles on the 10-mile range appears closer to the center of the scope on the 30 and 100-mile ranges, although it is the same number of miles from the aircraft because the range marks have been changed.

Our experimental radar was equipped with Isoecho contour circuitry as an aid in locating the areas of most rapid change in precipitation rate. *Fig. 8* shows what happens to a simple precipitation echo when the Iso-circuitry is tuned *On*. For all practical purposes this circuitry displays two rates of rainfall; the lighter rate defined by the outer edge of the echo and the heavier rate by the outer edge of the ISO hole.

Flight Procedures

Unlike previous thunderstorm probing research by the Thunderstorm Project, American Airlines and the Navy, where pilots went out of their way to find trouble by flying through the cores of thunderstorms, "Sir Echo" and its crew started out in June, 1953 to prove that thunderstorm conditions could be flown without getting into trouble; "trouble" meaning heavy turbulence, damaging hail and tornadoes. We knew from previous experience and research that the hard cores of thunderstorms were to be avoided and, from the work done by American Airlines, that heavy turbulence is usually associated with areas of most rapid change in precipitation rate. With Isoecho contour circuitry designed specifically to identify these storm areas, we looked forward with confidence to the task ahead.

Operations were conducted out of Denver and each morning during the evaluation program, the day's weather analysis was discussed by the Captain, Weather Advisor and Flight Coordinator before a plan of operation was formulated. Flights were usually planned with the goal of having the aircraft arrive in the expected thunderstorm area as the storms were developing.

The flight evaluation team included the Captain, the First Officer, Weather Observer and Flight Evaluation Coordinator. The cockpit scope permitted the first three crew members to make rapid and continuous comparisons of visual cloud appearances with the radarscope presentations. Notes on these comparisons were logged by the Weather Observer, who also kept a detailed weather log and took Polaroid and 16-mm colored moving pictures of cloud exteriors. The Flight Evaluation Coordinator, in addition to operating the radar, took radar pictures and maintained a detailed log of the settings of the radar controls for use in studying radar photographs during debriefing sessions and in preparing the final report.

The flight evaluation team and Meteorological Advisor met in debriefing

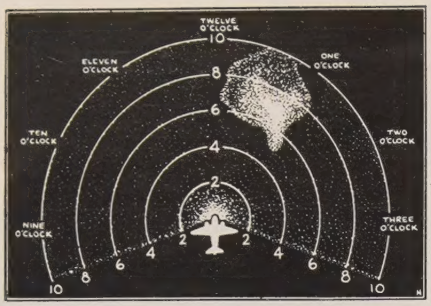


FIG. 5—*Info is presented as PPI display*

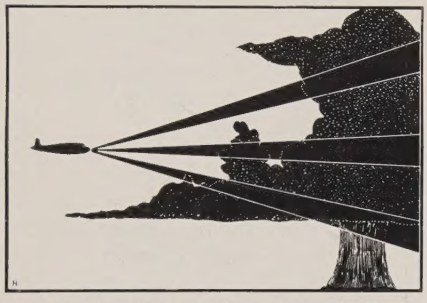


FIG. 6—*Antenna cut slices through clouds*

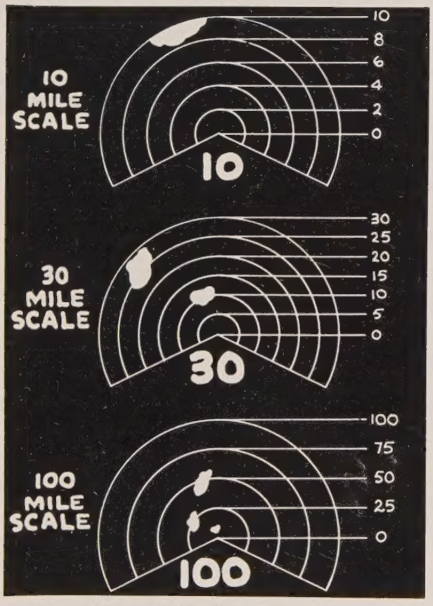


FIG. 7—*The RCA radar has three ranges*

sessions following operational evaluation flights, at which time radarscope photograph negatives were projected and studied and correlated with radar and weather logs, flight tracks, cloud pictures, weather maps, Ryan gust recordings, and personal opinions.

The flight evaluation program began on schedule on June 1, 1953 and in the next four months 40 technical and operational flights were made totaling 133 hours of flying, 80 of which were in the immediate vicinity of or through corridors of thunderstorms. More than 6,000 radarscope photographs were taken and over 2500 representative radar and cloud pictures were catalogued in two large albums.

Denver turned out to be a most desirable base of operations that could have been selected for during the evaluation an abundance of thunderstorms were available within less than 90 minutes flying time which permitted a sampling of all types of thunderstorms except the hurricane and true nocturnal. From a radar evaluation standpoint, we were fortunate to find more than a normal amount of hail, five cases of known tornadoes, and four cases of cloudburst or near cloudburst rain associated with the thunderstorms we flew. As an example of what we found within an hour's flying of Denver, on the afternoon of June 7 there were 50 confirmed tornadoes along and near the mainline airway between Denver and Des Moines.

Now that we've had a quick look at how the United 5.5-cm radar evaluation was conducted, let us take a brief look at the operational conclusions which were drawn from this evaluation:

1. The 5.5-cm radar is a very useful device for safer and smoother navigation of thunderstorm and precipitation areas and will permit a pilot to avoid moderate and heavier turbulence associated with these areas, usually by detours in the order of five miles or less from the planned flight path.

2. It will penetrate 15 miles or more of heavy rain equal to or greater than 60 mm/hour and will not lead a pilot blindly into the hard core of a storm.

3. It provides a satisfactory warning of hail shafts.

4. Even though we were unable to look at a radar picture and say "here is a tornado," there is considerable indirect evidence provided by the radarscope which will permit the pilot to avoid these violent storms merely by exercising ordinary good judgment in detouring sharp-edged echoes and—probably more important—in being highly suspicious of any finger-like projections from such echoes.

5. Using the "Safety Circle" technique, this radar provides a method of avoiding collisions with terrain. Antenna pitch stabilization is required when using this technique.

6. Terrain mapping capability of this radar is good.

7. Separation of storm and terrain echoes is feasible without added complexity of circular polarization. Circular polarization is of no value for distinguishing between hail and rain.

8. The radar has very little, if any, application in avoidance of other aircraft.

9. Isoecho contour circuitry is essential for determining which corridors in storm areas may be flown through with safety.

10. The scope display, while not bright enough for all conditions even though a hood was used, is useable until bright storage tubes are in production. The bright storage tube display must be capable of halftone reproduction.

11. Roll and pitch antenna stabilization are necessary to give a stable presentation devoid of serious intermittent ground mapping when observing weather echoes in rough air, and to provide a satisfactory display for use of safety circle techniques for terrain avoidance.

12. A 22-inch antenna provides adequate definition and justifies the installation of radar in aircraft which cannot accommodate a larger antenna.

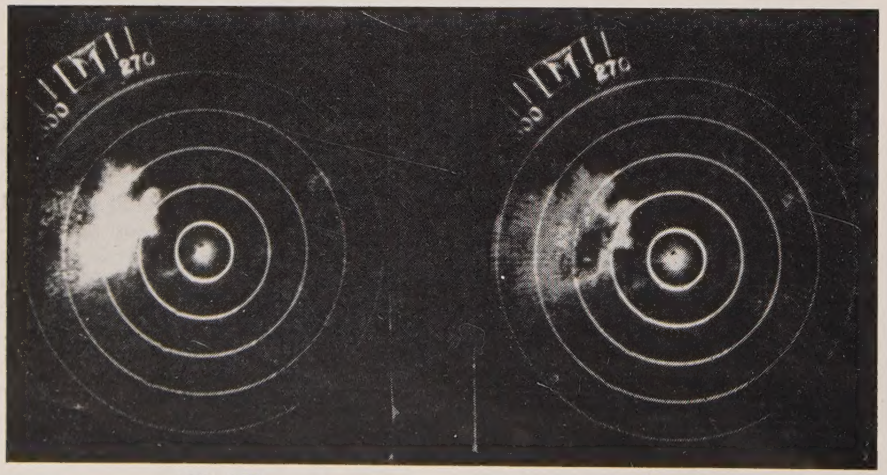


FIG. 8—*Isoecho contour circuitry located areas of rapid change in precipitation rate*

Turbulence

During the 31 flights operated under actual storm conditions in close proximity to storm cells, including circumnavigation, VFR traverses un-

(*Continued on page* 37)

Synthetic Oils for Turbine Lubrication

PART II: Review of Different Classes of Synthetic Oils

by H. A. Murray

Research and Technical Dept., The Texas Co.

Chlorinated Hydrocarbons

Chlorinated hydrocarbons are considered from time to time as lubricants. Their principal advantages appear to be good wear prevention or high E.P. properties and reduced flammability. Their principal uses appear to be confined to heat transfer fluids and certain non-flammable hydraulic fluids. For gas-turbine lubrication, the most serious objections (*Table I*) are poor viscosity-temperature characteristics, toxicity and very high rubber swelling. On the basis of present knowledge, this class of oil holds little promise as a turbine lubricant.

Discussions on chlorinated hydrocarbons often raise questions regarding the possible use of fluorinated hydrocarbons. While the latter exhibit remarkable oxidation resistance and high thermal stability, they unfortunately have three serious objections for use as turbine lubricants: first, poor viscosity-temperature characteristics; second, the range of temperature between freezing and boiling points is too narrow when compared with analogous hydrocarbons; and third, many exhibit bad rubber swelling characteristics.

Silicones

The outstanding property of silicones, as is well known, is the remarkably flat viscosity-temperature curve (*Table I*). Of all the pure compounds known today, silicones are by far the outstanding ones in this respect. For example, one of these fluids has a kinematic viscosity at 100°F. of 39.75 centistokes (roughly four times greater than Grade 1010 mineral oil) and at —65°F. 668 centistokes or about 3% of the Grade 1010 viscosity at this temperature.

Although silicones have unusually good oxidation resistance at moderate temperatures, it has been pointed out by W. A. Zisman and his co-workers of the Naval Research Laboratory that they have the unfortunate property of forming gels once they do oxidize. While the methyl phenyl substitution on the polysiloxane chain is noticeably better than the dimethyl polymer, it falls short of permitting its use in the aircraft turbine with safety. No practicable anti-oxidants have been found to improve on this property.

Boundary lubrication properties of silicones have been studied by the Naval Research Laboratory with over 156 metal combinations. With the exception of steel on steel, and a few other hard metals, all other metal combinations appeared to work about as well as mineral oil. With steel on steel the resulting welding and tearing was so serious as to limit the application of silicones to very low unit loads.

A third disadvantage is their poor adsorption by steel at ordinary temperatures and, therefore, poor protection to rusting. Of the three drawbacks perhaps the most serious one insofar as turbine lubrication is concerned, is the gel formation at high temperatures.

Organo Phosphorus Compounds

The principal advantages of organo phosphorus compounds for various aircraft uses are excellent wear prevention (or lubricity) and lower flammability (*Table I*). Other advantages of some are fair to good viscosity-temperature characteristics and lower volatility compared with mineral oils. For temperatures below 300°F. this class of compound remains fairly stable and is compatible with most metals. However, its chief drawback as a potential turbine lubricant is its poor thermal stability at high temperatures. The panel coking value (8 hrs at 600°F.) of a typical organo phosphorus compound is around 480 mg (*Fig. 7.*).

Hydrolytic stability of this class of compound varies from fair to good. This property is not as bad as is found with silicate esters but is not as good as the diesters. Those compounds which are susceptible to hydrolysis may form objectionable

TABLE I

COMPARISON OF VARIOUS SYNTHETIC OILS WITH MINERAL OIL

Kinds that meet viscosity characteristics required for aircraft gas turbines.

Requirement	Chlorinated Hydrocarbons	Silicones	Orango Phosphorus Compounds	Silicate Esters	Poly-glycols	Diesters
Viscosity-Temperature Characteristics	Poor	Outstanding	Fair to good	Excellent	Good to Excellent	Excellent
Volatility	High	Very low	Lower	Very low	Low	Very low
Thermal oxidation stability 400-600°F.	Fair to good	Poor to fair	Poor	Fair to poor	Fair	Good
Wear Prevention	Good	Poor	Excellent	Fair	Good	Good
Corrosion to Metals	Poor	Good	Fair	Good	Good	Good
Hydrolytic Stability	Fair to good	Good	Fair to good	Fair to poor	Good	Fair to good
Flammability	Less	Less	Less	Same	Same	Same
Rubber Swell	Very high	Low	Very high	Low	Same	High
Cost	High	Extremely High	Very high	Very high	High	Very high

FIG. 8—*Photomicrograph of silica formed from stability test of silicate ester fluid*

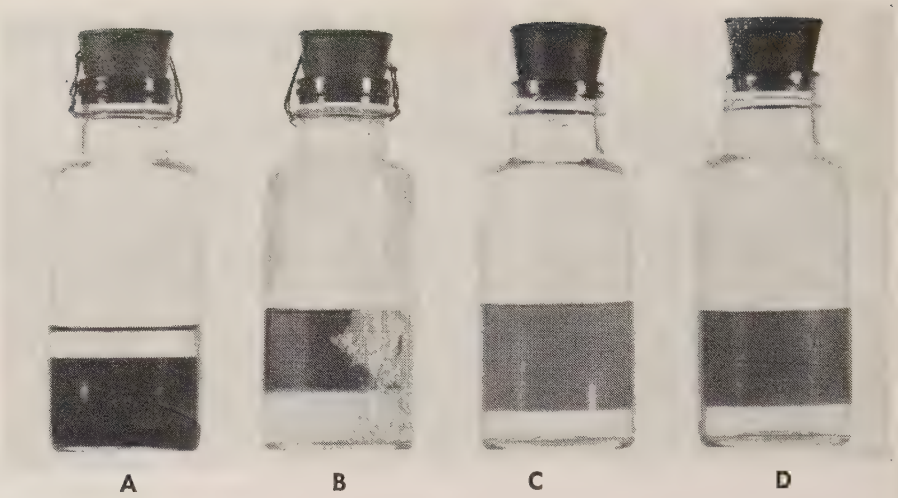


FIG. 9—*Stability Test: A) Organo phosphorous compound—satisfactory; B) Silicate ester —fail, note gel formation; C) Grade 1010 mineral oil—pass; D) Diester oil—passable*

amounts of corrosive phosphoric acids.

High rubber swell has presented some problems. However, progress has been made by changing formulation of the elastomers involved.

The principal uses of this class of synthetic oil for aircraft at present are for hydraulic systems of commercial aircraft, cabin supercharger drives and lubricating oil additives. In some respects, this class of fluid offers improvements over mineral oils for moderate temperatures up to 300°F. but should not be applied to turbines because of poor thermal stability at higher temperatures.

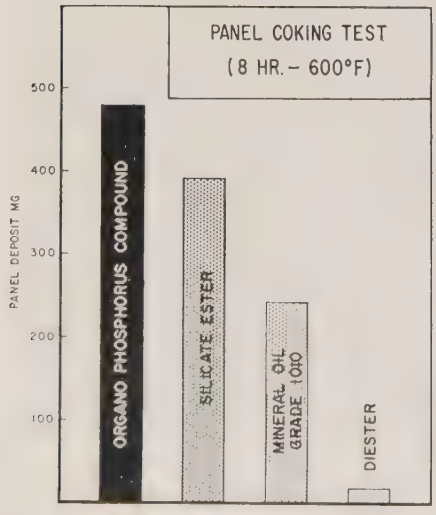
Silicate Esters

Silicate esters recently have attracted a considerable amount of interest as high temperature hydraulic fluids and turbine lubricants. From the simple physical tests, they may appear at first glance to be very attractive. For example, the viscosity temperature characteristics and volatility are outstanding (*Table I*). Their performance as gear lubricants appears satisfactory. These oils are non-corrosive to most metals and also possess relatively low rubber-swell tendencies.

Two very serious objections have been found thus far with silicates; first, poor thermal stability and second, unsatisfactory hydrolytic stability. Both of these disadvantages appear to be inherent with the structure of these fluids. Up to the present time, there does not seem to be a way to overcome them. For example, the Panel Coking Test value (390 mg) is very high (*Fig. 7*). Furthermore, the nature of the deposits are gritty and very abrasive. This limitation is such that the lubricant never should be exposed to temperatures in excess of 400°F.

Perhaps the most serious objection to silicate esters as potential turbine lubricants is their poor hydrolytic stability. What it means is simply this. Any water that comes in intimate contact with many of these silicates will cause them to breakdown, forming a gel and large quantities of abrasive silica (*Figs. 8 and 9*). On the basis of the latest knowledge concerning silicates, they do not appear promising for these purposes.

FIGURE 7



Polyalkylene Glycols and Derivatives

The polyalkalene glycols or polyethers and their derivatives are a very interesting family of compounds with an extremely broad field of application. As reported by J. M. Russ, the uses of these lubricants include internal combustion engines, gears, compressors, vacuum pumps, heat transfer fluids, fire resistant water base hydraulic fluids and many others. Both water soluble and water insoluble compounds are available in a wide range of viscosities.

The most promising of the glycols as potential turbine lubricants are the doubly chain-stoppered variety. These have excellent viscosity temperature characteristics and much lower volatility than mineral oil (*Table I*). An example of one of these experimental fluids appears on *Table II*.

Other characteristics that make the glycols attractive as aircraft turbine lubricants are good thermal stability, good wear prevention, non-corrosive to metals, low cost and good potential availability.

In the absence of oxygen, thermal stability of glycols is quite good, as illustrated by their use as heat transfer fluids where temperatures of 450 to 500°F. exist for extended periods. Their oxidation stability, however, is not too good although this objection can be largely overcome through the use of certain anti-oxidants. These oils exhibit a certain amount of solvent action for their oxidation products. The latter may be either soluble in the liquid or volatile. If the lubrication system is vented to the atmosphere to permit the volatile oxidation products to escape, the high-temperature components as well as the oil may remain remarkably free of sludge and deposits. The potentialities of glycols as turbine lubricants have not been fully realized especially where the more moderate low temperature starting requirements may be found. The greatest field for these lubricants at present appears to be for those turbines required to meet —40°F. starting temperatures, such as the present requirements of British turbines, as well as future civilian or commercial turbine types of powerplants. Mixtures of glycols and diesters at the present time also appear promising.

Esters

Monoesters as a class generally are

(*Continued on page 40*)

SKYWAYS FOR BUSINESS

NEWS NOTES FOR PILOTS, PLANE OWNERS OPERATING AIRCRAFT IN THE INTEREST OF BUSINESS

SEA HAWK, *a Bell Model 47G owned and operated by Hawk Helicopters charter service, heads for Glasscock Drilling's mobile barge on Shell's off-shore lease near Freeport, Texas*

Business Flying Shows Gain Over 1952 Number of Hours

Washington, D. C. A survey recently prepared for publication by the Civil Aeronautics Administration, reveals that business flying increased 16% in 1953 over the previous year. The 1953 total of 3,626,000 hours was 430,000 hours more than the revenue hours flown by all the scheduled airlines, domestic and international. The 1953 total also was 502,000 hours more than the 1952 total. Patrol, survey and other industrial flying activities showed an increase of 11% over the 1952 figure, while commercial agricultural flying showed an increase of only 2%.

In making the survey, the CAA sent questionnaires to owners of a representative group of 8400 airworthy aircraft. Replies were received from 76%.

At about the same time the results of this CAA survey were revealed, the Aircraft Industries Association reported that of a total of 21,500 aircraft owned by businesses throughout the nation, including fixed-base operators and flying schools, it estimated that approximately 12,000 were used exclusively for business trips by executives and essential business employees.

AIA studies show that the average plane used exclusively for business travel is operated an estimated 300 hours per year and in a 12-month period flies nearly 42,000 miles, four times the miles driven by most automobiles in a year.

In estimating the numbers of dollars these business aircraft save their operators each year, the AIA compared the cost of operating one of the smaller aircraft, with low seating capacity and slow speed, with rail transportation.

Using a lightplane with a cruising speed of 125 mph, a typical executive with a $12,000 per year income, and applying these factors to the calculated 3.6 million hours the 12,000 planes flew in 1953, the dollar value in salary savings alone would amount to $20 million.

Figured on this basis (plane costs 7.9¢ per mile to operate), the traveling executives flew a distance equal to more than 1800 trips to the moon. The total operating costs amounted to $35,550,000, but the time saved totaled the astronomical sum of 5,300,000 hours. That same distance traveled by rail would have cost $22.5 million, close to $13 million less than by plane, but the 5.3 million hours of executive times saved totals $33 million with a net saving to the flying businessmen of $20 million.

According to AIA, if figures were available for the faster planes and greater number of passengers carried, this amount would skyrocket. And it still would **not** include the additional business transactions made possible by the extra working hours resulting from the time saved by these planes.

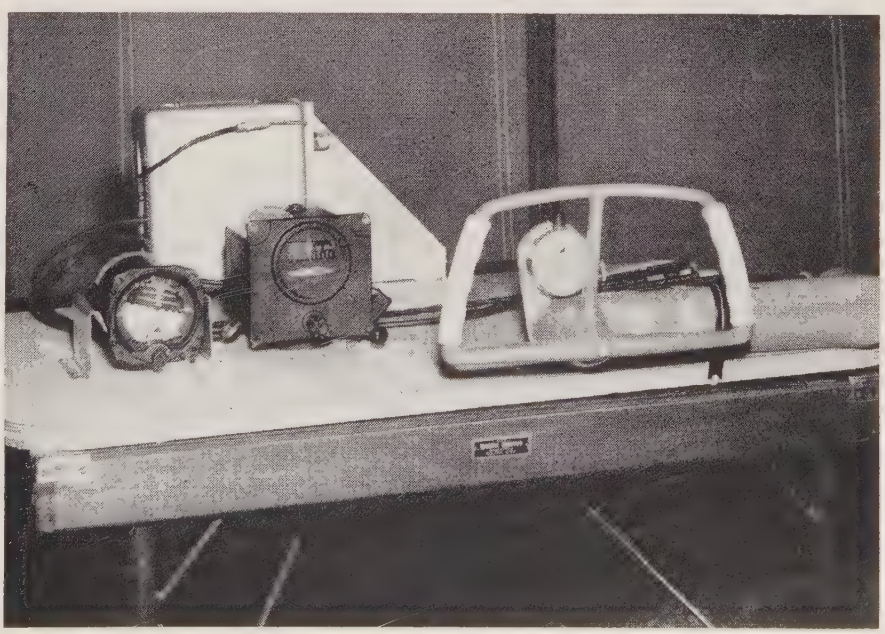
Oil Companies Call on Copters To Aid in Search for Oil

Fort Worth, Texas. Helicopters are joining the search for oil off the coast of Texas in increasing numbers. Most recent additions are two Bell 47G copters purchased by Hawk Helicopters of Corpus Christi, another 47G purchased by Magnolia Petroleum, and another by T. W. Murray Petroleum of San Angelo.

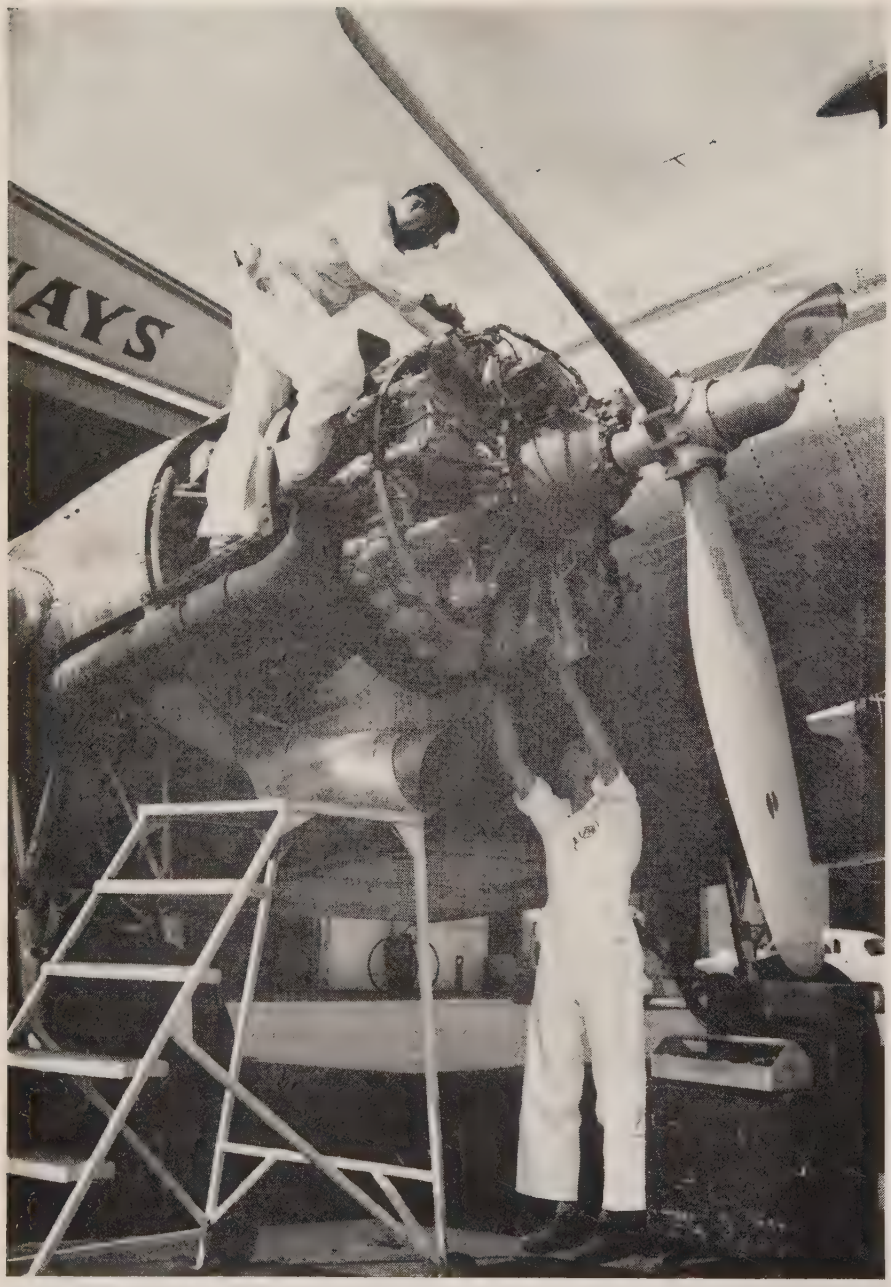
Magnolia Petroleum actually became the first major oil company to operate its own copter when it took delivery of its 47G early in November and the craft immediately went to work on Magnolia's offshore operation near Sabine, Texas.

Hawk Helicopters is a newly organized

(*Continued on page* 20)



MITCHELL CO-PILOT *was demonstrated for first time at NBAA's Dallas meeting. It is identified as an automatic co-pilot because it controls only two axes; it does not control pitch*



MECHANICS *completing installation of P&W R-2000 engine on a PAA DC-3. Exterior appearance is unchanged, except for larger oil scoop cooler, thinner and lighter prop*

Hi-Per DC-3

Latest modification of aviation's workhorse incorporates R-2000 engines and results include improved take-off, increased speed, load and altitude

Every year or so someone comes up with a "new look" Douglas DC-3 and the grand, old workhorse writes a new chapter in its illustrious and seemingly endless history of usefulness to aviation.

This year the "new look" for the aging veteran is the "Hi-Per DC-3," a transformation wrought by Pan American World Airways and licensed by CAA. The result is a DC-3 with a take-off gross of 26,900 lbs and true airspeed of 214 mph at 10,000 ft.

Pan Am upped the speed, payload and altitude of the DC-3 by substituting P&W R-2000D5 engines for the R-1830 powerplants. The R-2000 is rated at 1450 bhp for take-off, 1100 bhp maximum continuous, and a maximum available cruise power of 750 bhp. The R-1830-92 is rated at 1200 hp for take-off.

Results of Pan Am tests have shown that the R-2000 engine has boosted the critical altitude of the DC-3 by 2500 ft, and increased the altitude for maximum continuous power by 2800 ft. Avianca witnessed tests of the Hi-Per DC-3 at Bogota and is considering conversion of its entire fleet to the R-2000 as a result of the demonstration.

The North East Air Command of the Air Force has recommended the R-2000 installation for its Arctic based C-47's, which currently are using full take-off hp for taxiing alone and jet assist for take-offs from snow and ice runways.

The Pan Am base at Brownsville, Texas, is equipped with necessary tooling to perform the modifications on a production basis or it will supply kits for the modification in other

STAINLESS *steel accessory cowling and new flap shingles are major nacelle revisions*

shops. Complete sets of engineering authorizations, drawings and PAA Report No. 462, covering the Hi-Per modification, are available at minimum cost to other airlines, to fixed-base operators and to executive aircraft owners.

In addition to the R-2000 (either the D5 or the 7M2 must be used), the Pan Am power package on the Hi-Per DC-3 includes the following items:

Propeller—Hamilton Standard Hydromatic with 43D50 hubs and 6863A-1 blades.

Cowling—Standard DC-3 external cowling and new stainless steel accessory cowling.

Exhaust—A newly fabricated exhaust collector to reduce weight and increase ease of maintenance.

Oil Cooling—A new 13-inch AiResearch 87222 oil cooler has been installed, with provisions to eliminate flame propagation through the oil cooler in case of a fire in Zone 1 of the engine.

Cowl Flaps—A new set of cowl flap shingles has been fabricated to reduce maintenance difficulties. They also provide smoother flow of exit cooling air from the cowling and hold their settings in flight to a closer degree than the standard DC-3 flap.

Air Scoop—The carburetor airscoop has been completely redesigned to provide better ram air recovery and a higher critical power altitude for the engine than was possible with the standard DC-3 airscoop.

Fire Detection—A Zone 1 fire detector circuit has been installed in addition to the current Zone 2 circuit. A fire detector switch has been added to the instrument panel for use in testing Zones 1 and 2 fire-detector circuits prior to take-off.

Here is a step-by-step run-down of the re-work which must be accomplished in the modification of the Hi-Per DC-3 designed by Pan Am:

Nacelle Changes: Engine mount changed to C-47 type forged ring; new exhaust collector ring; internal re-work of ring cowling for larger diameter engine, and addition of a second cowl flap actuator cylinder for better flap control; new and heavier cowl flap shingles; new stainless steel accessory cowling; replace CO2 ring and propeller feathering line; replace propeller governor control system, inner fire seal assembly and electrical harness; replace obsolete type fire warning switches; replace accessory cowl carburetor air scoop with new type incorporating improved ram recovery; replace accessory cowl oil cooler scoop, install Eclipse Model 901 or equivalent generator.

Aircraft Changes: Install stainless steel doubler on nacelle fire walls and replace aluminum rivets with monel; install starter access door on fire walls; replace oil cooler bracket assembly and cooler; substitute new engine mount fittings; replace generator voltage regulators, control system and wiring; replace handle wobble pumps and cross feed fuel system with electric boost pumps; install dual hydraulic system cowl flap plumbing on each fire wall; install generator blast tube shut-off valve and linkage, and add an engine primer system on each nacelle; install a second CO2 bottle in the cockpit, geared rudder trim tab, C-47 type landing gear and fuel flow meters. Accessory changes are listed in following paragraphs.

Installation of a geared rudder trim tab for reduction of pedal forces, stainless steel accessory cowling, C-47-type landing gear, and modified CO2 fire fighting equipment completed the final steps in preparing the Hi-Per DC-3 to meet CAR 4b performance requirements.

The following accessories are used in the Hi-Per conversion: Eclipse 901 generator, Hamilton Standard 4G8 governor, Stromberg PD12F13-24 carburetor, Kollsman 879G001 tach generator, Thompson, TF-100 fuel pump, Pesco IP-582 hydraulic pump, Pesco B7-3P-207J vacuum pump, P&W 104212 vacuum pump adapter plate, and Hamilton Standard 43D50/6862A-1 propeller.

At a representative cruise weight, the level-flight speeds of the standard DC-3 and the Hi-Per conversion stack up as follows:

Standard DC-3 with the R-1830-92 at 9,000 ft and 600 bhp: TAS 180.

Hi-Per DC-3 with the R-2000 at 9,000 ft and 750 bhp: TAS 214.

This is an increase of 34 mph in effective cruising performance over the standard DC-3. Pan Am is proud of the fact that that extra margin of speed is part of a re-design program which also provides a higher level of operating safety for the dependable, old twin.

A. W. Kuhn, project engineer on the Hi-Per DC-3 modification, announced early in December that four of the nation's large overhaul and modification centers had been authorized by Pan Am to handle the conversion as approved by CAA, and that others probably would be signed before the end of the year.

The list includes Dallas Aero Service at Love Field, Dallas; Navco, Inc., at Lambert Field, St. Louis; Executive Aircraft Service at Garland Field, Dallas; and Northwestern Aeronautical Co. at Holman Field, St. Paul.

NEW POWER *package engineered by PAA gives the old reliable DC-3 additional hp per engine, provides better take-off performance, improved speed and a higher gross weight*

Hi-Per DC-3 Performance

Take-off (dry air) performance at SL:	
Gross Weight	26,900 lbs
Take-off Power	1,450 bhp
Maximum Continuous Performance:	
Max. Continuous Power	1,100 bhp
Critical Altitude R-2000-D5	9,800 ft
Cruise Power (max. approved) Performance:	
Gross Weight	26,000 lbs
Cruise BHP	750
True Airspeed	214 mph
Altitude	10,000 ft

PARTICIPANTS *at the Round Table held in Dallas, Texas during 7th Annual Meeting of NBAA were (left to right around table) Herb Fisher of Port of N. Y. Authority, Milton Carr Ferguson of Strato-Port Corp., J. O. Womack of Mustang Aviation, Randall H. Carpenter of Flight Safety Foundation, John Geisse of GeissGears, Joseph D. Blatt of CAA, Jim Dennison of U. S. Steel who attended as an observer, William Benedetti of Sprague Electric, Walt Pague of Armco Steel and the meeting's moderator, David G. Peterson of Sinclair Refining, Grove Webster, director of Aeronautics at Purdue University, and Art Jenks, Federal Airways, CAA*

SKYWAYS FLIGHT OPERATIONS ROUND TABLE

JANUARY 1955 — ***Hotel Adolphus, Dallas, Texas***

Role of the SINGLE RUNWAY in Future Airport Development

Moderator Walter C. Pague *(Chief Pilot, Armco Steel Corp):* "Gentlemen, it would be difficult to overemphasize the timeliness and importance of our subject under discussion today, namely, consideration of the role the single or one-directional runway will play in future airport development. We know that an airport configuration must be developed that will protect aircraft from obstructions in the approach zones and, at the same time, protect the people who live in the vicinity of the airport from hazards and noise. We know, too, that such a configuration would encourage the installation of landing facilities in countless small communities which, to date, have not been able to afford the building of complete airports.

"The National Business Aircraft Association is vitally interested in this airport problem. The lack of suitable landing areas in places where business-plane operators want to go seriously limits the utility of the business plane. Therefore, NBAA proposes that any airport program be designed to increase the number of landing areas throughout the country so that the business fleet can reach every industrial community. The criteria used in establishing the need for an airport should be based primarily on the extent of the community's industrial activity, and not be top heavy with consideration of airline passenger service potential.

"As you all know, a special airport commission was appointed by the President in February, 1952, to study the problem of airport location and use, and to report what could be done to solve the problem. Here is one significant paragraph from that report:

" 'A solution to many aspects of the airport problem is . . . the early acceptance of the single or parallel-runway design of airports with approaches over relatively clear areas. By this means, airport development could proceed along economical lines with minimum hazard and annoyance to neighbors.'

"The report then goes on to say:

" 'The commission feels that the one-runway (or parallel-runways) airport configuration is of great importance, not only from the standpoint of safety but in the interests of efficiency and future expansion. While an abrupt transition to the single-direction pattern is not possible at existing airports, steps in this direction are strongly advocated.'

"Of particular interest to us today, too, are the Air Coordinating Committee's recommendations 15 and 17 which urge the adoption of the single or parallel-runway design and the ac-

celeration of the programs of ground noise reduction by developing and providing adequate acoustical treatment in run-up areas and at test stands.

"To begin our discussion I'd like to call on John Geisse, president of GeissGears, former assistant administrator of the CAA and long-time proponent of the single-runway airport."

CAA Policy

John H. Geisse *(representing AOPA):* "I would like first like to comment on your statement that the Air Coordinating Committee accepted the recommendations of the President's Airport Commission relative to single or parallel runways. I am afraid it leaves the same erroneous impression left by some CAA press releases on this subject.

"In the ACC report the Department of Defense generally did concur in the recommendation, but the Department of Commerce concurred only provided the single or parallel-runway pattern provided a 95% coverage of a crosswind component of 15 mph. With this proviso their apparent concurrence is, in fact, a complete repudiation.

"In October, 1949, the CAA did adopt a single or parallel-runway policy, and it stated that Federal funds would not be used for any runway that was established simply for wind coverage; it had to be justified on some other basis than wind. Strange as it may now seem, even before that policy was adopted it had been endorsed by practically every organization interested in the subject. It was endorsed by the Non-Scheduled Advisory Committee, set up to advise the administrator on personal flying; it was endorsed by a resolution adopted by the Detroit Aviation Clinic; it was endorsed by AOPA and by practically all the State aviation officials. A letter from ALPA stated it would endorse the policy provided some of the dollar savings was used to increase the length of the runways. General Milt Arnold, vice president of ATA, gave his endorsement of the policy in a speech in Chicago.

"As far as I know, nothing has occurred between 1949 and now that has changed the picture, and yet the policy has been abandoned.

"Actually, the only change since 1949 has been further development of crosswind gears, more experience with them and, finally, the decision of the Air Force that there was to be crosswind gear on all B-52's.

"When the single or parallel-runway policy was adopted, we all recognized that existing airplanes would not be able to use such airports all the time, but we felt that we would not be depriving those aircraft of facilities because they would still have all the airports they had when they started to fly. Furthermore, we felt that adoption of the policy would enable us to get more airports and more accessibly located airports than we would otherwise. Therefore, we felt that in planning airports of the future we should consider the airplane of the future rather than those that would be soon out of service. It was our opinion that as long as we had demonstrated it was possible to build aircraft to operate satisfactorily from single-runway airports or to modify them for such operations at reasonable expense, we were justified in changing the airport program, particularly when that change meant a saving of from 25% to 50% in the cost of construction."

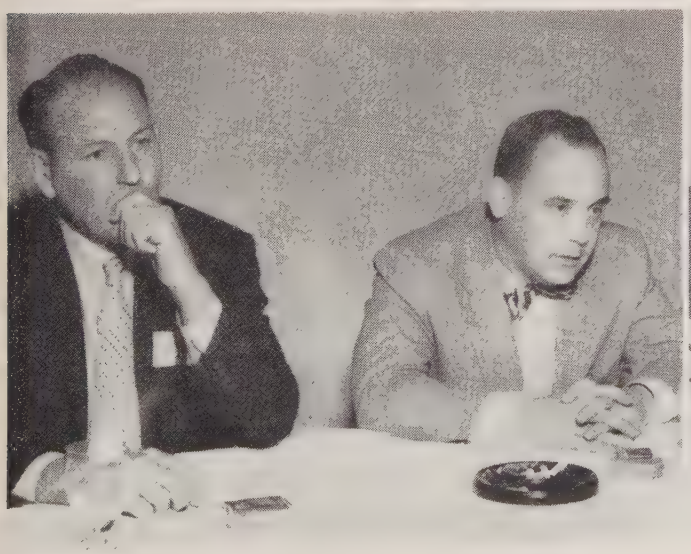
Walt Pague: *"As the representative of the CAA, Mr. Blatt, do you have any comments regarding Mr. Geisse's remarks?"*

Joseph D. Blatt *(Asst. Adm., Program Coordination, CAA):* "There seems to be some confusion over the use of two terms—agency policy and a principle. It is the policy of the CAA in administering the Federal Aid Airport Program to adhere to the basic principle of a single-runway airport. That is still our policy, but this should not be construed to mean that it is the policy of the CAA to reject projects contemplating multiple-runway configuration. As we interpret it, the single-runway principle is that specific and detailed justification will be required for the construction of additional runways. On the basis of traffic volume or on operational reliability with respect to wind coverage, or both, a second runway may be justified. That justification should show quantitatively that the cost of the additional runway is commensurate with the value of the operational benefits to be derived by the utilization of the additional runway.

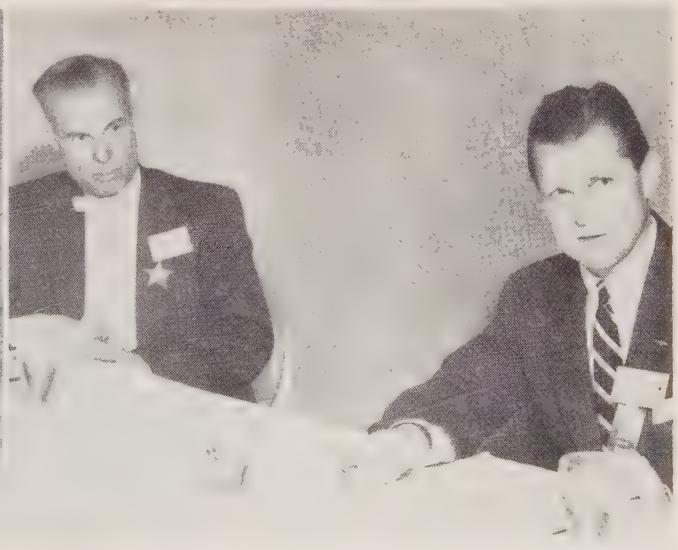
"Mr. Geisse mentioned that we must design our airports for the aircraft of the future, but I would like to call your attention to the fact that 83% of the present civil air fleet is still equipped with conventional landing gear. That is a definite limiting factor in airport development."

Appropriations Eligibility

Walt Pague: *"Mr. Blatt, can you discuss appropriations for multi-runway type airports as compared to funds for one-directional runways?"*



*"**DOWN** here, 50 to 100 private pilots go into a one-runway strip with no tower and have no trouble," said Womack (left)*



*"**SINGLE** or parallel runway configuration," said Walt Pague, "is becoming a necessity from standpoints of safety, economics"*

Round Table Participants

WALTER C. PAGUE has been chief pilot of ARMCO since 1945, following service as Navy transport pilot during World War II. Mr. Pague served as Moderator of meeting.

ARTHUR E. JENKS won his ATR in 1932 and joined CAA in 1940 as Aeronautical Inspector; transferred to Federal Airways, '45; became Chief, Flight Inspection in '50.

J. H. GEISSE, president of GeissGears, Inc. is former assistant administrator of CAA. He is graduate mechanical engineer and today specializes in crosswind gear work.

RANDALL H. CARPENTER, manager of Air Transport Div., Flight Safety Foundation, is former American Airlines captain. During war, he served with USAF's ATC.

MILTON CARR FERGUSON has been engaged in private law practice in Washington, D.C. since 1940, specializing in product development; is pres., Strato-Port Corp.

J. O. WOMACK, president of Mustang Aviation, has been a leader in civic and aviation matters in Texas since he learned to fly in 1930; holds a Commercial license.

GROVE WEBSTER, director of Aeronautics, Purdue University, was director of the CAA's CPT program during World War II; he learned to fly as an Army pilot in WW I.

WM. G. BENEDETTI, manager of Flight Dept., Sprague Electric Co., served as a Navy dive bomber pilot during World War II. He joined Sprague Electric Co. in 1951.

HERBERT O. FISHER, chief, Aviation Development Div., Port of N.Y. Authority, spent 14 years as engineering test pilot for Curtiss-Wright; has over 10,000 hours.

DAVID G. PETERSON, chief pilot of Sinclair Refining Co., spent war years with Boeing and Beechcraft in Wichita before joining Sinclair in '44; began flying in '31.

JOSEPH D. BLATT, Asst. Adm. for Program Coordination, joined the CAA in 1937. He has been especially active in development of executive and private flying.

J. D. Blatt: "With respect to the Federal Aid Airport Program, our appropriations are not premised on either a single-runway configuration or a multiple-runway configuration. First, we determine whether or not there is a sufficient degree of national interest in a project to warrant Federal aid. Note that I said 'a sufficient degree' of national interest. There is some national interest in almost every airport and airport project in the U.S., but we have to measure the degree before we can determine the project's eligibility.

"At the present time we have established criteria which requires 3,000 enplaned airline passengers or 30 based aircraft, or some combination of the two, to bring about project eligibility. We are not saying that 30 based aircraft in themselves are the measure of national interest. That is merely the yardstick, an indication of large itinerant business, a measure of the total use being made of the airport.

"We then establish a priority for the specific work to be done at an airport. Obviously, such things as land acquisition for approach protection or paving of primary runways get highest priority.

"I can unequivocally state that in allocating funds on eligible airports we give consideration to the single-runway principle in giving the highest priority to the primary runway on the airport.

"The majority of the work being done under the Federal Airport Program is on existing airports. Out of about 150 projects approved in the current fiscal 1955 program, only three were for new airports; about 147 were for modification anad improvements on existing airports. Obviously, the existing airports are multi-runway types, but we are expending our money by giving the highest priority toward the improvement of the major or primary runways on these multiple-runway airports."

Walt Pague: *"In other words, we can't anticipate the construction of new one-runway airports on any great scale in the immediate future?"*

J. D. Blatt: "Not necessarily. Airports will be constructed with the assistance of the Federal Aid Airports Program and within the budgetary limitations of the funds we receive from Congress, on the basis of the degree of national interest. If there is sufficient national interest in single-runway airports, they certainly will be eligible under the Federal Aid Airport Program."

Single-Runway Operations

Walt Pague: *"Mr. Peterson, how do you as a business pilot feel about this single-runway configuration?"*

David G. Peterson *(Chief Pilot, Sinclair Refining Co.):* "The fleet of business aircraft continues to grow because we are able to go when and where the passengers desire. The more airports, the more utility. There are today some 6,000 airports, some of which have single runways. In 10 years of business flying I have never had to alter plans because of crosswinds. It seems to me that two one-runway airports at different locations would double the utility of these business machines compared with that from having one airport with two runways or more.

"Some of our airports would be more usable for aircraft out of the *Cub* class if the number of runways were fewer and the length longer. It might be well to have a short runway 90° to the main runway for slow aircraft when the wind condition is extreme."

Walt Pague: *"With single-runway airports, one of the major problems*

"TWO *one-runway airports at different locations would double utility of a business plane compared to that of one airport having two runways," declared D. Peterson (right)*

"CAA *authorized the airlines," reported J. Geisse (left), "to use crosswind gear on DC-3 up to 40-mph crosswind component"*

"STRATO-PORT *concept," explained M. C. Ferguson (right), "is reduction of crosswind by means of a fence that filters the wind"*

involves wind direction and velocity. Do you consider this to be an important factor in your operation, Dave?"

Dave Peterson: "We very seldom encounter a condition that demands more than the one runway. Under a low-ceiling and poor-visibility condition, most pilots would rather land crosswind or even downwind on an ILS approach than make a range, an omni or circling approach. Under bad-weather conditions I usually make a straight-in approach on ILS. Though it is a small-airplane operation, I do go into a single-strip airport on the State Fish & Game property near a lake in Oklahoma. I've seen as many as 25 airplanes on this field on a Sunday and there has never been the slightest incident, such as a ground-loop, as the result of that operation. The Cessna 195's, 170's, 140's, *Bonanzas, Navions,* etc., have landed there without any difficulty."

Walt Pague: *"What percentage of flights have you cancelled or found necessary to change equipment due to strong crosswinds?"*

Dave Peterson: "Very few, if any. I've never cancelled a trip there yet."

R. H. Carpenter *(Mgr, Air Transport Div, Flight Safety Foundation):*

"Reliability of operation, despite the weather, is as much your goal as it is the airlines. Therefore, it might be appropriate to point out that when you make the transition from instrument to contact at 400 or 500 feet, it isn't much of a problem to pilots of your experience. However, when that transition is made at 200 or 300 feet, even a slight deviation from line-up with the runway will result in a missed approach. Obviously, you can't premise the construction of an airport on the probability that it will be used 100% of the time, but you should consider the fact that, with the development of landing aids, business-aircraft operators are going to be just as interested in 200 and one-half as the airlines are.

"The people who propose the single-strip runway are predominantly those who are able to land on them because they are familiar with the necessary techniques, but you are placing a burden on the less-experienced pilot by asking him to land crosswind.

"Without any consideration of the economics involved but only an interest in operating techniques, it would seem to me that a single-strip runway of considerable length and oriented properly with regard to the prevailing wind would be ideal only if a spur, in the form of a V or an L oriented 310° or 315°, also were provided. Perhaps the initial touchdown area would have to be only 600 or 700 feet long, followed by a grass strip. Obviously, where you have to land into such winds, you need a correspondingly shorter runway."

Strato-Port Project

Walt Pague: *"In the general field of single-runway airports, there has been considerable research and engineering data collected in the interest of what is known as the Strato-Port project. Mr. Ferguson, would you care to comment?"*

Milton Carr Ferguson *(Pres., Strato-Port Corp):* "As our company sees it, if we can find or develop a one-directional airport system which can cope successfully with both crosswind components and ground-noise radiations, we will have solved the most serious problems of airport location and cost. The Strato-Port project grew out of a concept which was discussed at some length in *SKYWAYS* in August, 1952. The article was titled 'One-Way Airport,' and the idea it reported on has since come to be known as the Strato-Port Project.

"Briefly, the Strato-Port concept is the reduction of crosswind components and noise radiation on runways by means of specially designed screens that filter the wind or sound waves. Such screens probably would be 50 feet high and would run the entire length of the runway on either side or, perhaps, be placed from 500 to 1,000 feet apart. Furthermore, the screens should be designed so as to control the reduction of crosswind components in progressively greater percentages from each end of the runway to the touchdown point, thereby affording additional safety and ease of operation to aircraft entering the air harbor.

"From the very beginning of the Strato-Port Project, the technical staff of the National Air Coordinating Committee was consulted and has since been kept fully advised of the wind-tunnel and engineering findings as the project has developed.

"The CAA issued a staff study which it entitled 'An Evaluation of the Strato-Port Concept.' Although the CAA concluded that until full-scale tests could be made, all conclusions necessarily would be theoretical, the CAA did find that wind-tunnel tests gave promise of successful operation of the full-scale model and offered possibilities as a noise-reduction device for take-off and run-up operations.

"It might be interesting to note here that the only other effort to build barriers to crosswind runways is a solid wall which the British built at one of their experimental airstrips shortly after World War II. Although the principal purpose of that wall appears to have been to shield the surrounding area from noise rather than to control crosswind components on the runway, actual flight tests under crosswind conditions were made and,

(*Continued on page* 33)

Oil Companies Call on Copters To Aid in Search for Oil

(*Continued from page* 13)

commercial helicopter charter firm. One of its two copters currently is working on Shell Oil's off-shore lease near Freeport, Texas, while the other one is under charter by Western Natural Gas and is assigned to Western's drilling operations nine miles off the coast from Palacious, Texas.

The T. W. Murray Petroleum 47G is being used for executive transportation from its main offices to scattered drilling sites.

According to George Hawn, president of Hawk Hellicopters, more and more oil companies are discovering that copters pay their own way as aerial ferries for off-shore operations. Considerable savings are being realized through use of helicopters by reducing many time-consuming boat runs to and from the coast and barges, decreasing the number of personnel boats needed.

Mitchell Introduces New Automatic Airboy Co-Pilot

Mineral Wells, Texas. An automatic co-pilot which weighs 7½ lbs and draws only 2.5 amperes of power has been developed and placed in production by Mitchell Industries, Inc. It is being marketed as the *Airboy Co-Pilot* and is priced at $1,181.50.

Demonstrated for the first time during the annual meeting of the NBAA in Dallas, the new instrument generated much interest among pilots of single-engine equipment (*See photo, page* 13).

Components of the *Airboy* include a small motor attached to the control wheel, an artificial horizon, a directional gyro, and a 4-lb power supply. It is unnecessary to connect the Co-Pilot into the control cable system of a plane and the motor can be attached by substituting a gear nut for a sprocket nut and using two straps to hold the instrument in place.

The *Airboy* is identified as an automatic Co-Pilot because it controls only two axes. It does not control pitch.

Company Pilot Named to Naval Advisory Committee

Waltham, Mass. George E. Bottjer, chief pilot and manager of flight test for Raytheon Manufacturing Company, recently was appointed to the Naval Aviation Advisory Committee. The appointment was made by I. H. Smith, Jr., Assistant Secretary of the Navy for Air, on recommendations from the commanding officer of the South Weymouth Naval Air Station.

As chief pilot for Raytheon, he is in charge of the electronics firm's fleet of aircraft, including an experimental jet aircraft based at Raytheon's radar development lab adjacent to Hanscom AFB, Bedford.

CAA Presents Award

Philadelphia, Pa. Emil M. Farris, flying businessman of Philadelphia, received the Honor Award of the CAA at a dinner meeting given for Mr. Farris by the Union League Club. Fred Lee, Administrator of the CAA, presented the award to Mr. Farris in recognition of his long participation in, and promotion of aviation.

. . . . in the business hangar

Aetna Finance Company, St. Louis, recently bought a Model 50 *Twin Bonanza* from Remmert-Werner. A Lear L-2 autopilot with altitude and approach controls, a Lear ADF-12, a LTRA-6 VHF and an ARC 15D Omni were installed in the 50 by R-W.

Paul Smith Construction Company's Twin Beech has been in the Aerodex hangar for minor repairs. Home base for the D18 is Nassau, Bahamas.

Ronald Stoner brought Cherokee Textile's Aero *Commander* to Remmert-Werner for installation of Collins 17M-51X VHF communications, ARC Omni with Omnimeter, a Lear 3-light marker, a Grimes Rotating Beacon, and custom radio and switch panels.

Paul Holst brought Michigan Tool's *Lodestar* to Executive Aircraft Service for 100-hour inspection, installation of new de-icer boots and miscellaneous repairs. The airplane is based in Detroit.

International Paper Company's Lockheed 18 has been in the hangar at Lockheed Aircraft Service, New York, for 100-hour inspection. Carl Lund, chief pilot, flew the plane up from Mobile, Ala.

National Lead Company's DC-3 is back in operation following installation of Collins 17L-3, 51R-3 and RMI equipment, plus a Sperry C-4A system. The work was done by Usher Aviation at New Haven, Conn. Bob Olsen is National Lead's chief pilot and NBAA representative.

Gopher Aviation at Rochester, Minnesota, is installing all the radio and electronic equipment in a new Beech Super E18 recently purchased by Pillsbury Mills, Inc., of Minneapolis.

C. J. Viosca, pilot for Anderson-Dunham, brought his company's Aero *Commander* to Horton and Horton Custom Works at Meacham Field, Fort Worth, for exterior painting. The company's color scheme of red, yellow and white was used in the custom design. Baton Rouge is home base for the *Commander*.

Walsh Construction Company has had its *Lodestar* in Mallard Industries' shops for relicense, left engine change, tank patching, replacing of control cables and an overhaul job on the liquidometers. Fred Leslie is Walsh's chief pilot.

Brown Paper Mill Co., Inc. is flying its newly converted DC-3. Conversion was done by Executive Aircraft Service and features a luxurious interior, with a photo mural on the forward bulkhead and a TV in the aft bulkhead. Interior fabrics and colors are a blending of browns, beige and green. Powerplants are new R2000's and the -3 is equipped with a Sperry Autopilot and engine analyzer, Super DC-3 wheels and brakes, retractable tail wheel and the latest in safety equipment. The airplane is based at Orange, Texas, and its pilots are R. F. "Wimpy" Neel and Ben Duhon.

An Eclipse-Pioneer PB-10 autopilot and a Bendix DME recently was installed in Libbey-Owens-Ford Glass Company's DC-3 by Remmert-Werner. Tracy Service is pilot and his company's NBAA representative.

AiResearch recently completed executive interiors in a Convair 340 owned by The Chicago *Tribune*, a DC-3 belonging to Reynolds Metals and a B-23 for Pittsburgh Consolidation Coal Company.

B. F. Goodrich Co. has its *Lodestar* back in operation after installation of a new communications and navigation system. System includes a dual Collins Integrated Flight System, Sperry Gyrosyn compass system, Wilcox two-way VHF communications, custom cabin entertainment facilities and custom-built overhead remote control panels. Tep Parsons, pilot, and H. R. Earnest, copilot, run the *Lodestar's* front office. K. R. Sadler is Goodrich Company's NBAA representative. Qualitron, Burbank, did the work on the *Lodestar*.

Earl Slick's Douglas A-26 recently was in the shop at Piedmont Aviation for installation of additional Collins radio equipment. Jack Davis is pilot of "The Bombshell."

Walt Pague had Armco Steel's DC-3 at Remmert-Werner recently for modification of the -3's center section attach angles. Walt is chief pilot and also a member of the Board of Directors of NBAA.

Official NBAA Report

NATIONAL BUSINESS AIRCRAFT ASSOCIATION, INC.

(formerly Corporation Aircraft Owners Association)

National Business Aircraft Association, Inc. is a non-profit organization designed to promote the aviation interests of the member firms, to protect those interests from discriminating legislation by Federal, State or Municipal agencies, to enable business aircraft owners to be represented as a united front in all matters where organized action is necessary to bring about improvements in aircraft equipment and service, and to further the cause of safety and economy of operation. NBAA National Headquarters are located at 1701 K Street, N. W. Suite 204, Washington 6, D.C. Phone: National 8-0804.

Long, Useful Life for DME CAA Tells NBAA Delegates

Pilots attending panel discussions during the three-day annual NBAA meeting at Dallas were urged by CAA to buy and use VOR/DME now, rather than to wait until the controversial, military-sponsored TACAN system is introduced.

Donald M. Stuart, director of the CAA's Technical Development Evaluation Center in Indianapolis, told NBAA delegates that TACAN is not much of a threat to DME at present. In fact, he said, TACAN competition is 10 to 12 years away and DME will therefore have a long and useful life before it is replaced by another system.

Department of Labor Rules on Pilot Wage-Hour Exemptions

Delegates also were informed at the Dallas meeting that NBAA has been assured by the Department of Labor that professional business pilots and copilots working on a straight salary or fee of $125 or more per week are exempt from provisions of the wage and hour law *if* they have an ATR or commercial and instrument rating and at least 1200 hours. The Department of Labor declined to approve a blanket order identifying all business aircraft pilots as professionals and therefore eligible for exemption under the wage and hour law.

Reorganization Plan Being Studied by NBAA

Member-delegates assembled for the 7th annual meeting voted approval of a study to determine whether NBAA should be reorganized for greater service to members. Under a proposed plan, four regional vice presidents would be selected and each given a territory to administer. Each vice president would appoint committees to handle safety, communications, technical developments, public relations and legislation.

Pilot Proficiency Education Program to be Aided by CAA

With the assistance of CAA, the Association is planning to establish a continuing program of education in the fields of safety and pilot proficiency.

Chairman William Strong of the NBAA Safety Committee advocated that each member pursue a continuous training program for his operation. He also recommended that operational procedures be standardized throughout the business fleet.

When a member suggested during the panel discussion on safety that perhaps the CAA should be requested to restrict instrument flying by single-engine aircraft, it was the consensus of the panel that the pilot rather than the aircraft should be penalized.

Business Pilots Urged To File Malfunction Reports

Although they are not now required in the non-scheduled field, aircraft malfunction reports should be filed voluntarily by NBAA members and freely exchanged within the organization, according to a CAA spokesman at the annual meeting. Such reports from certificated airlines are required by law.

IFR Rooms Established At New York Airports

Herbert O. Fisher, chief of aviation development for the Port of New York Authority, announced at the convention that an IFR room has been provided at Idlewild and that the PA and CAA are planning similar rooms at LaGuardia and Newark airports. These rooms, he said, take the ASR, PAR and other equipment for instrument approaches and landings out of the control tower cab so that men working this equipment and the controllers have more space and can work without interfering with each other.

With such a set-up, Fisher explained, greater freedom can be exercised in the use of radar approach control, in addition to the radar departure control now in effect. This should improve airport capacity which, during IFR, is already ahead of center capacity.

Fisher also reported that studies of the New York Center are underway to develop equipment to improve coordination between sector controllers, thus tending to eliminate manual recording on strips. These strips, which have run as high as 9,000 per day, complicate interchange of information.

The Port Authority and the CAA also are planning additional remote transmitters to enable towers to communicate directly with pilots over a greater area, and a long-range radar installation to permit vectoring of aircraft on radar departures to distances well beyond those possible today. The latter also would make it possible to use additional radar procedures for inbound aircraft.

Ultimately, Fisher said, instrument runways at LaGuardia, Idlewild and Newark will be bi-directional, permitting instrument approaches from the northeast as well as from the southwest.

NBAA *elected Seaborn P. Collins, National Commander of the American Legion, as its Honorary Member #1. He was main speaker at the NBAA's 7th Annual Dinner*

Cole Morrow Earns Jet Instructor Rating

Cole H. Morrow of the J. I. Case Company in Racine, Wis., retiring chairman of NBAA, has successfully completed a jet pilot instructor's course at Moody AFB in Georgia. The course included simulator time and flight time in the T-33 trainer. In five days of intensive flying, Morrow and other students taking the course were in the air for 22 hours. Art Jenks and Ernie Burton of the CAA were among others who passed the course with Morrow. Morrow had previously been checked out in a McDonnell *Banshee* fighter.

New Aircraft Designs

New aircraft designs were discussed during the annual meeting, but it was the consensus of delegates that current aircraft will continue to hold the spotlight for some time to come. A substantial number of delegates indicated that the DC-3, modernized and equipped with R-2000 engines, will continue to play a leading role in the business-aircraft field.

R. James Pfeiffer of Convair announced that Long, Parker & Associates have been named representative for Convair sales to corporation operators. At the same time, he pointed out that Convair believes its equipment (240 and 340) is limited in its adaptability to the executive market because of initial cost and upkeep. He urged NBAA members to make careful analyses before deciding on his company's aircraft. One 340 being converted on the West Coast will cost $800,000, a price which includes cost of the aircraft and its conversion and equipment.

Instrument-Approach Aids Installed

Business pilots can now look to the coming winter season in anticipation of vastly improved airport ceiling and visibility forecasts to aid them in low-weather approaches. Instead of the present tower observation every 12 or 15 minutes, pilots will have available a new ceiling measurement every six seconds.

Final details are now being completed for a U. S. Weather Bureau program for installing new weather measuring devices at major air terminals. Installations have been completed at New York's three major airports and at Washington National Airport. During the next 18 months, similar facilities will be installed at more than a dozen other key cities.

The USWB project represents a double-barreled attack on the weather problem. First, it applies the latest in technical know-how to get the most accurate readings of ceiling and visibility. Secondly, the instruments are located in the runway approach zone where the pilot actually experiences the weather, instead of at some remote station or airport site convenient for the observation.

Airports slated to have new instruments are Chicago (Midway), Los Angeles, San Francisco, Seattle, Portland (Ore.), Detroit, Kansas City, Pittsburgh, Cleveland, Philadelphia, Boston, Fort Worth, and Anchorage. All were chosen on the basis of exposure to instrument landings during year-round operations. According to 1953 CAA statistics, the 17 airports selected account for 40% of all instrument approaches.

If traffic growth estimates run true to current forecasts, Weather Bureau officials feel that 53 airports eventually will qualify for the new facilities.

Climb-Out Guide Light Experiment at LaGuardia

"The vertical light beacon in Flushing Meadows Park to guide aircraft taking off from LaGuardia Field, and keep them away from populated areas," said F. B. Lee, Administrator of Civil Aeronautics, U. S. Department of Commerce, "is an experiment, and should not be regarded as a precedent for CAA action. The light will be helpful to pilots only on night takeoffs. Such a course is followed easily in the daytime, and the light will mark it adequately for night takeoffs."

"We are glad to cooperate with the NATCC which has worked out this plan," Mr. Lee said. "This vertical beam, coming from a 60-inch searchlight will aid pilots, we hope, to avoid low flying over residential areas along the line of this runway. The CAA, the NATCC, and the New York Port Authority will observe its effectiveness, and we will determine later whether the cost of its operation (about 3600 a year) by the CAA is justified."

"The light will be installed by the NATCC in the park adjacent to 69th Road, with a control line connected to the traffic control tower at LaGuardia so that it can be turned off when not needed. Pilots taking off from the long runway (#13) at LaGuardia toward the southeast will turn slightly to the right when over Flushing Bay and fly over the park toward the light, approximately four miles away. By the time they have reached the light, the average transport should be at an approximate altitude of 1500 feet, and their subsequent turn over residential areas would not then be objectional to the people below."

Think Twice About This!

The Air Force has developed some interesting figures which show the relationship between degree of bank, wing load factor and stall speed. These figures should make every pilot think twice before attempting steep turns within several hundred feet of the ground.

Whenever a turn or bank is executed, the wings not only carry the weight of the airplane but are immediately required to carry a load imposed by centrifugal force, and the greater will be the lift required to overcome the additional load.

Here are the facts—

If an airplane grosses 2,000 pounds and has a rated stall speed of 50 mph, the following will be true:

(1) At a 30° *steady* bank the wing load is 2,000 lbs x 1.15 = 2300 lbs. The stall speed is 1.073 x 50 = 53.6 mph.

(2) At a 60° *steady* bank the wing load will become 4,000 lbs. The stall speed is 70.7 mph.

(3) At an 80° *steady* bank the wing load will become 11,520 lbs; the stall speed, 120 mph.

Using the above figures, the approximate wing loading and stall speed may be calculated for your airplane for any degree of *steady* bank. It is important to know that the above figures hold true *only* for a steady bank. If an abrupt pull-up is combined with a steep bank then the wing load will be much greater and the stall speed will increase very much beyond the figures shown.

High-Speed Stalls: An abrupt pull-up at high speed not only zooms the stall speed of an airplane but, if carried to the extreme, may cause structural failure. Assume an airplane, which has a normal stalling speed of 40 mph, is flying at 120 mph. The pilot pulls the stick back abruptly; what is the load imposed on the wing? What happens to the stall speed?

The velocity is 120 divided by the normal stalling speed of 40 which will give a figure of 3 and three squared is nine, which is the wing load factor developed in this type of abrupt pull-up. If the airplane weighs 2,000 pounds, a load factor of nine would require the wing to carry 18,000 pounds momentarily which is 9 g's and may cause structural failure.

If the wing and structure held, what would happen to the stall speed under these conditions? The stall speed multiplication factor is equal to the square root of 9 (load factor) which is three. Therefore, the normal 40 mph stall speed would be boosted to 120 mph, which is what is known as a *high-speed stall.*

It now becomes obvious if a steep-banked turn is combined with an abrupt pull-up, it is impossible to fly fast enough to stay out of a stall.

The moral pointed up by these mathematics is this: *Stay clear of steep turns or abrupt pull-ups near the ground. You may not get a second chance.*

Fatigue

During an approach for a landing, the pilot let the left wing drop and the aircraft turned away from alignment with the runway. Pilot had levelled off by the time the aircraft touched down on an unimproved area of the airport. The gear switch had been placed in the "up" position and the gear retracted as the aircraft ran through a swampy depression.

Crew "on duty" time this date was 16-1/4 hours.

AIRCRAFT ADVISORY COMMITTEE *of National Business Aircraft Association met in Dallas to discuss aircraft designed for business use. Committee (left to right) Cole Morrow, retiring Chairman; Ralph Piper of Monsanto; Henry Boggess, new NBAA Chairman; C. F. Zimmerman, Continental Oil; Bob Kusse, Fruehauf; C. G. Talbot, G. E.; Gerard J. Eger, International Harvester; and Vic Swanson, Sears Roebuck & Co.*

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Map shows major routes of these 18 Super Constellation airlines:

(Figures represent total unduplicated route miles for each airline.)

- Air France 162,000
- Air-India International 16,100
- AVIANCA (Colombia) 28,500
- Cubana (Cuba) 8,600
- Deutsche Lufthansa (Germany) 11,200
- Eastern Air Lines 12,700
- Iberia (Spain) 41,000
- KLM (Holland) (144,000)
- LAV (Venezuela) 16,700
- Northwest Orient Airlines 17,300
- Pakistan International 5,200
- QANTAS Empire Airways 68,800
- Seaboard & Western (All-cargo routes applied for)
- TAP (Portugal) 11,300
- Thai Airways (Thailand) 19,700 (proposed)
- Trans-Canada Air Lines 19,000
- TWA-Trans World Airlines 33,000
- VARIG (Brazil) 19,000

Insignia on map show airline headquarters.

Every month another airline starts *Super Constellation Service*

To you this means that soon you can fly more places faster, in greater comfort than ever before . . . on big, fast, luxurious transports that are world-renowned for dependability —*Lockheed Super Constellations* . . . now with turbo-compound power.

Already more new Super Constellations are being built to airline order than any other comparable air transport . . . ordered by more than twice as many leading world airlines. So many, in fact, that every month during 1954 a different airline started Super Constellation service. This record is continuing in 1955.

More world airlines (18) have ordered the Super Constellation than any comparable transport—worth remembering next time you fly.

Lockheed

AIRCRAFT CORPORATION

BURBANK, CALIFORNIA, AND MARIETTA, GEORGIA

Look to Lockheed for Leadership

EXECUTIVE COPTER *introduced to NBAA members by Bell Aircraft was on receiving end of much interest. Here, Jim Fuller of Bell (left) details the helicopter's features to Fred Lee, CAA Administrator, and Cole Morrow, retiring NBAA Board Chairman*

DISCUSSIONS *started early. At breakfast in the Century Room of Hotel Adolphus Delos W. Rentzel (left), Henry W. Boggess and Ralph E. Piper pitched opinions prior to start of NBAA meeting. All three are members of NBAA's Board of Directors*

NBAA 7th Annual

CATCHING *a practice golf ball at the "Cowboy Stomp" netted this NBAA member a prize package wrapped in a chute, but "it" didn't stay wrapped long. Unfortunately, the winner didn't get to keep his prize. That's Southwest's Al Harting at the mike*

NBAA SPECIAL CITATION *was presented to William T. Piper, Sr., president of Piper Aircraft, by retiring NBAA Chairman Cole Morrow. Joining in applause for the presentation are (left to right) Dwane Wallace, Bill Lear and Beech's Leddy Greever*

PANEL DISCUSSIONS *of problems associated with business-aircraft operations attracted member-pilots attending the meeting. Among group at this session were Walt Pague (left), Chief Pilot for ARMCO Steel. Seated next to Walt is Robert Hewitt*

HANGAR SESSION *brought members of Communications and Air Traffic Control Panel together for pre-meeting confab with Herb Fisher, N. Y. Port Authority. Panel members were (left to right) H. Roberts, ATA; C. Rice, Bendix; Gil Quinby, NARCO*

SHADES *of Liberace were evident at NBAA luncheon when Jim Riddle of NARCO went to "work" on the organ while Tom Neyland of Taylor Oil and Gas, and Tony Aguilar of Associated Radio provided suitable substitutes for the "trademark" candelabra*

Meeting, Dallas

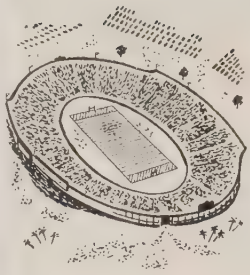
SAFETY AWARDS *went to 68 pilots representing 41 NBAA member-companies. Here, Earle Bauer, Ohio Oil pilot and assist. manager of aviation activities, accepts his award from Jean DuBuque, executive director of NBAA, while Henry Boggess, new chairman of NBAA's Board, looks on. Bauer flew 574,920 accident- and injury-free miles during 1954*

1954 NBAA SPECIAL AWARD *went to Donald M. Stuart, director of CAA's TDEC, for his outstanding contribution to air navigation development. Lindbergh was '53 winner*

SIZING UP *the situation at the "Stomp" are Cowboys S. J. Manette, Cities Service Oil Co., and Patrick Golden, Swiflite Aircraft Corp. Boss "cowpoke" and the man in the middle here is George C. Pomeroy, Chief and NBAA rep for Swiflite Aircraft Corp.*

ANOTHER SPECIAL CITATION *winner at the 7th Annual NBAA Banquet and Honors Night was Bill Lear, Chairman of the Board of Lear, Inc., photographed here showing his citation to Fred Lee, CAA Administrator. Speaker at the dinner was Seaborn Collins*

PLANE FAX



Your Best Week-end Flight Plan for January

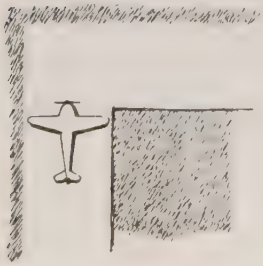
Fly to Los Angeles for the Rose Bowl game and the Tournament of Roses parade. Plan to land at any of the airports near Pasadena that carry quality Standard Oil Aviation products. Refer to your Directory of Standard Airport Dealers for their names and locations.

Wolf hunting by air above the Arctic Circle

Glacier-hopping wolf hunts are just part of the day's work for Frank Whaley, who is the Kotzebue, Alaska, pilot and station master for the Wien Alaska Airlines. In 50-below-zero weather, he flies over icy mountain ranges in search of reindeer-killing wolf packs, then throttles down to fly at 60 feet above the snow, within shotgun range of the killers.

"Low flying at slow speed is never easy," says Mr. Whaley, "and when it's done at temperatures way below zero while headed toward a canyon wall, I want to be sure that I have plenty of extra power available. We've found that Chevron Aviation Gasoline 80/87 gives us more power on take-offs and a greater reserve of power in flight than any other fuel we've tried. Chevron 80/87 always gives us superior performance, even in bitter cold, and never fouls our spark plugs.

"And because we pre-heat oil almost to the boiling point before starting any engine, the oil we use must be of exceptional quality. RPM Aviation Oil withstands this rugged treatment, where other oils break down. What's more, "RPM" keeps our engines running smoothly for long periods, even under our extreme operating conditions."



TIP OF THE MONTH

During the run-up before take-off, it's always a good idea to make sure the carburetor heat mechanism is operating properly, especially in cold weather or before high-altitude flights.

T.M.'S "RPM," "CHEVRON," REG. U.S. PAT. OFF.

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Sperry Announces New IFR Instrument System

As has been said many times before, the ultimate goal of most aviation instrumentation development is to eliminate the inherent distinctions between visual flight and instrument flight. When the pilot can "see" his altitude, flight path and forward panorama on instruments as obviously as he can in daytime CAVU, enroute and instrument approach problems will no longer be the costly factor they are today when measured in successful flight completions.

To do this, instrument companies (of which Sperry Gyroscope is a leader) have come out with new and better instruments for IFR flight. Normally, each such development has meant additional scanning for the already over-burdened pilot's eyes and mind. Too few times, has it been the replacement of an obsolete instrument with a better one, telling the instrument flight story a little better.

The latter is true of the Sperry Integrated Instrument System. Combining the Zero Reader flight director, and the gyro-horizon into one instrument, the HZ-1 Horizon Flight Director not only tells the pilot how to move his controls to best intercept and follow a desired flight path but also shows his pitch and roll attitude at all times.

Behind the familiar "fly right or left" and "fly up or down" cross-pointers of the flight director is a horizon sphere which simultaneously portrays aircraft attitude throughout unlimited maneuvers. The resultant effect is close to that of flying a practice ILS approach with the Zero Reader on a VFR day. Furnishing data to the flight director is a lightweight, tubeless Sperry Z-4 Computer that provides more stable coupling to ILS signals during manually flown approaches. In fact, the system has been specified as part of the new A-121 Gyropilot to go into the new PAA fleet of Douglas DC-7C "Seven Seas" aircraft now under construction.

The second instrument of the system is the C-6 Gyrosyn Compass, which replaces the current RMI type and gives the pilot improved radio cross-bearings directly on a new dual-reading master dial which is free from repeater errors, thus offering greater accuracy flying enroute courses or critical instrument approaches. A settable course marker on the compass dial (note the arrow-head indice on

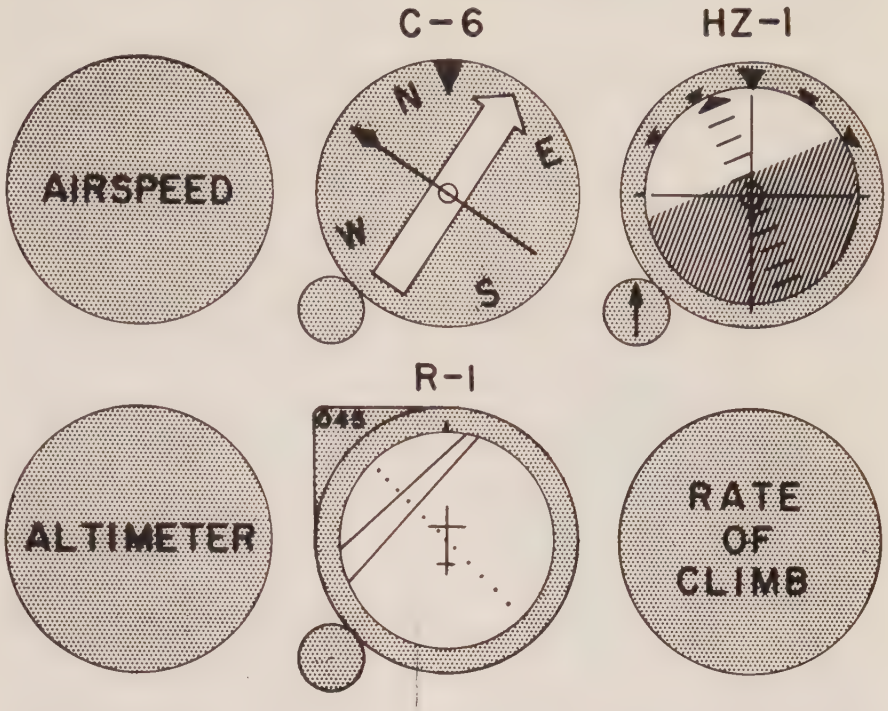
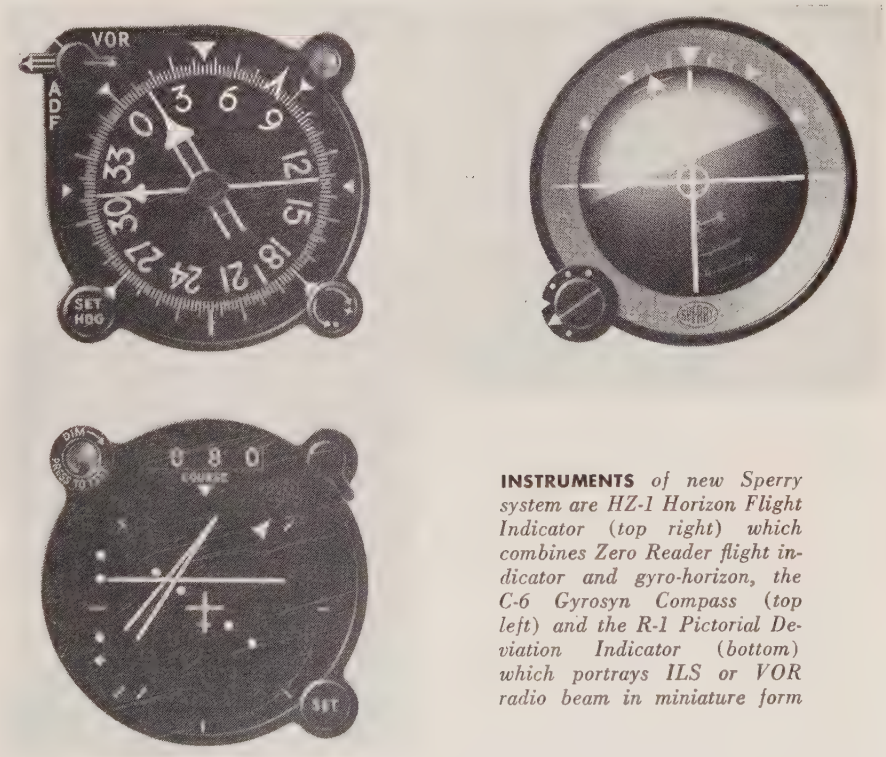


DIAGRAM *shows how three panel instruments of new Integrated Instrument System fit into standard simplified panel of the "basic six" flight instruments without needing extra space*



INSTRUMENTS *of new Sperry system are HZ-1 Horizon Flight Indicator (top right) which combines Zero Reader flight indicator and gyro-horizon, the C-6 Gyrosyn Compass (top left) and the R-1 Pictorial Deviation Indicator (bottom) which portrays ILS or VOR radio beam in miniature form*

80°) improves the presentation for the pilot and also serves as the Heading Selector for the flight director's computations. Note also that the double needle is on the ADF and indicates, in the familiar manner, the magnetic bearing of the L/MF radio facility to which it is tuned, perhaps an ILS Outer Compass Locator. The single needle is on the VOR *or* ILS which is being employed and indicates that the aircraft is currently crossing a

track of 311° on a magnetic heading of 045° to intercept the desired VOR *or* ILS course of 80°. Also, of course, the Flight Director indicates that the aircraft *is* on the optimum heading and attitude to most effectively accomplish this.

The third element of the system, the R-1 Pictorial Deviation Indicator replaces the standard ILS cross-pointer instrument and gives a pictorial representation of the airplane's position and heading relative to the desired VOR or ILS course. The use of a narrow converging V-shaped bar in lieu of the conventional thin localizer course needle is interesting and more realistic in terms of the actual transmitted signal and as shown on all charts. The new indicator also incorporates an omni-bearing selector by which the pilot can choose any VOR radial desired to be flown. Localizer and glide slope deviations on this instrument are displayed as on present ILS indicators and serve as a factual reference familiar to the pilot for comparison and use with the computed data displayed by the flight director.

The net result of the availability of Sperry's new system is that, solely by replacement of the equivalent older instruments on the pilot's panel, better and more flyable flight reference data is available with an actual reduction in the net burden of instrument scanning. Although not by nature competitive with the "visual" reference data supplied by airborne radar presentations newly appearing on the market, the Integrated Instrument System may well prove a preferable interim step on the way to "all-visual controlled" IFR flight operations.

Air-Aids Spotlight

BINGHAMTON, N. Y.—*ILS-LOM on 317 KC decommissioned, replaced by H facility on same frequency (BFM) located 8 statute miles from end of runway; check for revised procedure.*

BISMARCK, N. D.—*LF Range now 338 KC.*

CHICAGO, Ill.—*CHI TVOR on field on 116.2 mc.*

COEUR D'ALENE, Idaho—*4° northward swing of north leg of LFR has resulted in reversal of quadrants on south leg crossing Green 2 between SPOKANE and MULLAN PASS.*

DENVER, Colo.—*All IFR traffic operating off-airways KANSAS CITY-direct-CHEYENNE and west are requested to report to DENVER ARTC over IMPERIAL VOR rather than south leg of NORTH PLATTE LFR.*

MILWAUKEE, Wis. — *Airport Surveillance Radar services now available.*

MINNESOTA — *State-owned TVOR's operating as follows: BIMIDJI Airport (BJI) 111.2 mc; BRAINERD (BRD) 109.2 mc; EVELETH - VIRGINIA (EVN) 108.2 mc; INT'L FALLS (INL) 111.8 mc; ST. CLOUD-WHITNEY (STC) 111.6 mc. Check for status before using.*

NEWBURGH, N. Y.—*STEWART AFB (West Point) LF-Range now NHW on same freq.*

NEW YORK, N. Y.—*LAGUARDIA Tower abandoning guard on 122.5 mc used by smaller private and business pilots; adding 122.7 mc to other published frequencies. Tower advises 122.5 virtually useless due to other towers in area. CHICAGO and LOS ANGELES and others to follow.*

PROVIDENCE, R.I.—*Approach Control exercising Low-Altitude Control at 3,000 feet and below between PVD, No. Central and New Bedford airports.*

SARNIA, Ont.—*LFRange on 404 KC changed to MHW same freq.*

SCRANTON,WILKES-BARRE, Pa.—*Newly commissioned combined Insac-Approach Control tower guards 121.3 mc, 121.5 mc, 121.9 mc, 122.1 mc, 122.5 mc, 126.7 mc, 135.9 mc, 255.4 mc and 3023.5 kc. Transmits 121.3 mc, 121.5 mc, 121.9 mc, 122.2 mc, 126.7 mc, 135.0 mc, 135.9 mc, also 248 kc and 272 kc (LFRange).*

Portable Ground Control Unicom Now Available

One of the drawbacks to more extensive use of radio control of ground vehicles on busy airports is the limitations of separate units, expensively installed and maintained in each vehicle. Hence, such installations are restricted to a minimum and when occasion arises where other special vehicles must make an infrequent foray upon the active airport area, a radio-equipped vehicle and driver must be provided as escort.

The Gonset Co. of 801 S. Main St., Burbank, Cal., offers a truly portable VHF two way unit that, while primarily designed as a new, better and cheaper Unicom ground unit, is equally valuable as a portable ground-control unit for vehicles and is completely self-contained. Operating on either 6 volts DC or 115 volts AC, it can be used from an office desk or a standard automobile with minor adaptations of the source of power. Transmitter is crystal-controlled on either 121.7, 121.9, or 122.8 mcs, and the speaker installed in the unit tunes over 108 mcs to 128 mcs.

Total equipment weight is approximately 20 lbs. Coax fitting on top of housing mounts telescoping antenna (supplied) or connects to feed line from external antenna. Accessory kits available include coax cable and fittings, ground plane antenna and microphone (crystal or carbon) with desk standmount.

Country-Wide Coverage by DME Nears Completion

No installation program of any previous navigational facility has approached that of the DME when it comes to rapidity and reliability of installation. As of the end of July 1954, over 250 of the programmed 450 DME's were in operation and over 90% of these were commissioned. It is expected that all will be operational by this time next year.

It may be important to mention that the DME installation differs operationally from typical VOR installations in that a non-commissioned station in operation does not present a serious navigation hazard (as do other radio nav-aids) in that it cannot give an erroneous signal. Either you receive it correctly or the airborne receiver "hunts." In a public service bulletin issued by NARCO, a leading producer, this point is not made to encourage indiscriminate use of non-commissioned facilities, but to emphasize a characteristic that can be of vital importance in an emergency.

Of the over 60 DME stations operational in Region One (Northeast U.S.), six or more are associated with ILS installations at major terminal airports and the rest with VOR along the airways. Three of the over 62 in Region Two (Southern states) are associated similarly with ILS, the rest with VOR.

Region Three (Middle West) shows approximately five of the almost 60 DME's associated with ILS and Region Four shows four ILS-associated installations and over 60 VOR-associated.

As the bulletin points out, the flight test for commissioning a DME station involves, among other things, a definition of the range-altitude coverage patterns of the signal. A non-commissioned station may have poor coverage from this standpoint which will deny a DME-equipped aircraft a reply until the airplane is fairly close overhead. But this absence of a reply is not a navigation handicap such as was found with VOR commissioning procedure in which a non-commissioned station might have serious course errors.

Thus, says Mr. Quimby, Sales Manager for NARCO, DME is in existence on the airways to an extent which makes it useful for enroute and approach navigation on *most* of the well-traveled routes, and at most of the high-density terminals in the U. S.

TELEX Twin-Set Dons Earmuffs for Winter

The familiar TELEX Twin-Set earphones have earned such a welcome place in the cockpit that the company, of St. Paul, Minnesota, shouldn't mind a little kidding. In fact, until their lightweight, cool and airy product came along, pilots only put up with the hot, sweaty, old-fashioned rubber-cushioned "cans". Even the frequent shortcomings of employing a cockpit speaker were compensated for by the final TELEX product which permitted simultaneous radio guard and intra-cockpit or cabin conversation without the unsanitary as well as uncomfortable ear plug which foreran the Twin-Set.

Undoubtedly, complaints of cold ears did not sponsor the addition of the very attractive and light transparent plastic muffs. More likely, too many of the little white tips on the end of the adjustable sound arms were shoved into ear canals accidently, or lost some other way.

Bendix Markets New Flush-Mounted Magnetic Radio Compass Antenna

With every effort being made to increase the performance of existing business aircraft without resorting to the necessary large capital outlays for aircraft in the new airline categories, emphasis is being placed on increased power and decreased drag.

Along the later line, the Type LPA-70A Magnetic Antenna has been developed by Bendix to provide a flush-mounted automatic radio compass antenna of virtually no drag. In addition, its primary feature is its anti-noise characteristics, more sensitive null point, decreased shielding effect by the aircraft structure and better directivity.

Designed for mounting in a shallow cavity of the skin on either the top or lower surface of the aircraft, reception of electrostatic interference and precipitation static are so minimized that dependability of the radio compass system is greatly increased.

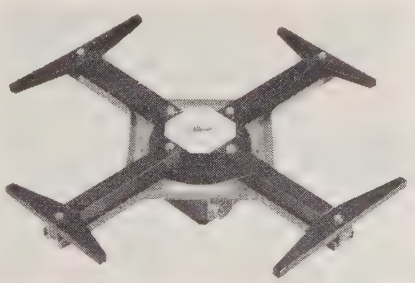
The basic difference between this and the loop-type antennas is the use of the four ferrite collector bars extending radially from the center at intervals of 90°. These are sensitive only to electromagnetic energy and concentrate the radio frequency field around a small iron core loop coil. Crosswise at the ends of the collector bars are bolted smaller ferrite corrector bars.

The later serve to correct for error caused by quadrantal distortion of the radio field, in lieu of the older cams system. Variable lengths of corrector bars are available and will serve for all normal installations.

The equipment is interchangeable with any Bendix ADF equipment, and may be substituted for the MN-36, MN-60, AS-313, or AT-269 radio compass loop antennas. Performance is equal to and generally better than these antennas.

No change in the operating procedure of a radio compass system results from conversion to the magnetic antenna. The usable frequency range extends from below 90 kc to 1800 kc, and is supplied for either 100-cps or 400-cps power sources.

The entire structure measures approximately 17 by 17 inches, fits in a cavity 1.5 inches deep (the drive motor, autosyn and connectors require a hole less than 4 inches square in the center of the floor of the cavity), and weighs approximately 8 lbs. A Fiberglas plate to cover the cavity is available with the antenna, and is coated with an erosion resistant paint that has sufficient conductivity to drain electrostatic charges.



LPA-70A *is Bendix magnetic ADF antenna*

a narco Sapphire PRODUCT

Range knob changes scale to 0-20 miles

DME

DISTANCE MEASURING EQUIPMENT

SO USEFUL, SO NECESSARY

- Gives exact continuous distance from VOR/DME or ILS/DME stations
- Permits more direct instrument let-downs
- Gives more accurate ETA's
- Checks ground speed and winds aloft
- So useful in hundreds of ways for safer, easier, more economical IFR and VFR operations

YOU need DME

You'll want Narco DME because

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- Lightest in weight (only 32 pounds complete)
- Requires least power
- Uses ruggedized ARINC tubes
- Carries unrestricted CAA Type Certificate
- Backed by a nation-wide factory-trained service network
- 0-20 mile scale gives extremely accurate readings for final approach operations or orbiting

See your nearest distributor or send for brochure describing the Narco DME.

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industry notes . . .

■ General Electric has its J47-GE-33 jet engine (7,650 lbs thrust) in production at its plant in Schenectady. All future North American F-86D *Sabrejets* will be equipped with the new, more powerful J47, with afterburner.

■ The third F2Y-1 *Sea Dart* is expected to begin flight testing by the end of this month (January) at Convair's San Diego base. Extra work crews have been assigned to the *Sea Dart* to expedite completion so that trials, broken off when the second *Sea Dart* was lost in an accident over San Diego Bay, may begin again at the earliest possible date.

■ Dallas Airmotive, Inc. has received one of the largest contracts ever awarded by the USAF for the overhaul of airplane engines. With this new contract, Dallas Airmotive becomes the nation's largest engine-overhaul facility, with some 300 Pratt & Whitney R-1830 engines going through overhaul each month.

■ A New York Airways' S-55 recently became the first S-55 to log over 3,000 hours in the air. Licensed N-405-A, it is the same S-55 with which New York Airways began mail service between the three major metropolitan airports (LaGuardia, N.Y. Int'l. and Newark) in October, 1952. New York Airways has five of these copters and plans to purchase more. NYA's passenger service recently was extended to White Plains, N.Y., and Stamford, Conn. Passenger service previously had been available only between the major air terminals and Trenton and New Brunswick, N.J.

■ General Dynamics Corporation's Convair XFY-1 VTO fighter recently made military history when it was operated at high speeds in horizontal flight. From a runway at Brown NAS, the XFY-1 rose vertically at 7:27 am, and a few seconds later leveled off into a high-speed horizontal course. The transition from vertical to conventional flight was made at an altitude of 175 ft. At the end of the flight, the test pilot nosed the XFY-1 skyward, hovered a few seconds, then backed down, tail-first, to the runway.

■ North American's latest model *Fury*, the FJ-4, recently completed its first flight. Produced by the Columbus (Ohio) Division, it was flown by Engineering Test Pilot Dick Wenzell for 59 minutes. Powered by a Curtiss-Wright J65 engine (7,800 lbs thrust), it has a top speed in excess of 650 mph.

■ Beech Aircraft has signed an additional supplementary agreement to its USAF contract for T-34 military trainers. The additional contract totals more than $4,300,000, including aircraft and spare parts, and extends the production of the T-34 until 1956.

■ The first successful flight of an airplane controlled by an autopilot using transistors instead of electron tubes has been revealed by Bendix Aviation Corp. The flight actually took place last May, but military considerations banned release of the information. Further flight tests with the completely transistorized PB-20 autopilot system installed in a Bendix B-25 are going on, and another transistorized autopilot has been delivered to WADC for evaluation in high-performance aircraft.

■ British nuclear authorities anticipate solution within five years to the principal problems incident to the production of atomic-powered aircraft. The British experts further declare that atomic-powered airplanes may actually be flying within 10 or 15 years, and that the atomic engine finally developed will be a turbojet rather than a propeller-type.

■ A USAF flight surgeon and two organizations which have performed distinguished service in achieving safer utilization of aircraft recently were presented Flight Safety Foundation awards. Lt. Col. John P. Stapp, of the USAF Aeromedical Field Lab, was honored for his research on the decelerative forces which the human body can withstand. TDEC of the CAA received one of the awards for its in-flight fire and fire-detection work; and United Air Lines received an award for its development of anti-collision lights.

Skyways Round Table

(*Continued from page* 19)

as the Strato-Port project's wind-tunnel tests indicated would happen, very disturbing areas of turbulence were generated as the result of using a solid wall to fence the runway.

"The nearest thing to a full-scale Strato-Port was the landing strip the Air Force cut through the forest at St. Germaine during World War II. That strip was 500 ft wide and the trees along the side were about 50 ft tall. Operations into and out of that strip were quite successful. Trees, of course, are not as scientific a way to screen a runway from crosswind components as a predesigned actual screen would be, nor could you move trees around the way you could a screen."

Walt Pague: "*Acceptance of the Strato-Port idea would mean a revolutionary change in our present concept of airport construction. Let's have some comments regarding this Strato-Port idea. Herb Fisher.*"

Herbert O. Fisher *(Chief, Aviation Development Div., Port of N.Y. Authority):* "The Port Authority is interested in any new development and we have spent considerable time and effort on the Strato-Port idea. We feel that it has some good points, but we also feel that, from an operational point of view, there are some items to be overcome, particularly in its application to the New York area. Generally, however, our feeling is that until a full-scale model is established and a number of pilots have an opportunity to fly it under various crosswind conditions, we will have to sit tight and see what transpires. Obviously, if we ever had to build airports, we'd prefer to have to build only one runway. However, the situation in the New York area—800 aircraft movements in one day, snow and ice at certain times, etc.,—calls for more than one runway.

"Even if one runway could handle all the traffic, if there was an accident or repairs had to be made to the runway, we just couldn't close the airport for the necessary period of time. So, we'd have to have another runway, and this one, preferably, would run at some angle to the first one.

"Frankly, I have serious misgivings about this business of one runway, particularly in areas where you have so many different aircraft using that one runway."

J. O. Womack *(Pres., Mustang Aviation):* "I certainly agree with Dave Peterson, on any single runway that would be usable 95% of the time, but I disagree with Mr. Carpenter's contention that the pilot with less experience would not be able to use it. On various air tours we've had down here, I've seen 50 to 100 private pilots go into a one-runway strip without any tower control at all, and they've had no trouble.

"Some of you newcomers to Texas may not realize it, but we actually have a form of Strato-Port down here. W. L. Smith, Fly and Fish Inn, at Caddo Lake, became so excited about a fishing park that he put in a strip similar to the one Mr. Ferguson mentioned the Air Force had built in Germany during the war. Instead of its being 500 ft wide, this strip is barely wider than the span of the airplane, and the pine trees are a good 50 ft tall. I have gone in and out of this strip when the crosswind was 40 mph and, while there has been some turbulence, it has worked out very well. The strip is 5,000 ft long and is cut right out of the pine trees.

"At the last convention of the Texas Aviation Trade Association we requested the Texas Aeronautics Commission to aid in building 100 new airstrips in the state. We asked that these strips be built in every county seat in the hope that we'd get the men in the Legislature behind us. During the last Governor's race in Texas, both candidates used airplanes a great deal of the time, but in many cases they had to drive 40 to 60 miles from an airport to get to a county seat.

"I don't feel that we will get Federal aid for the small fields. It's going to be up to the state and municipalities, but we hope to get the 100 more that we need."

Walt Pague: "*Going back to Herb Fisher's comments regarding the New York area, I'd say New York is in a rather enviable position as far as high-density traffic is concerned because that area has four major air terminals in operation. But where a city has no major air terminal, perhaps it is faced with this matter of building a multi-runway airport because that has been the precedent over the years.*"

Herb Fisher: "Our concept at New York Int'l is two parallel runways east and west, and two more north and south. We feel that we have to have the additional N/S Runway 422 for greater future capacity for instrument work, whereas the other two parallels, 13 and 31, are long and will take about anything in the foreseeable future."

Dave Peterson: "Recently, a runway was closed for construction work, Herb, and I'm wondering if you have any figures on the number of aircraft that passed up a landing due to that work. You had only one runway available for a short time."

Herb Fisher: "I don't have any figures on that. Actually, Runway 422 has only been closed for short periods of time, and as far as I know there aren't any figures on the landing cancellations because of having only one runway.

"We do have numerous complaints, however, when we try to keep airplanes landing on Runway 13 at La Guardia when perhaps they should be coming in on 4. We try to keep the approaches away from the congested area and when pilots come in on 4 they come over Jackson Heights, whereas 13 brings them in over the water. ALPA and other groups have set up 15 mph as the crosswind criteria, and soon as the crosswind gets up into the 15-mph area the pilots want their runway changed to Number 4 right away. The Port Authority would like to see that crosswind criteria raised because it would materially help our community problem."

Walt Pague: "*Mr. Jenks, would you care to comment on this subject?*"

High-Speed Aircraft

Arthur E. Jenks *(Chief, Flight Inspection Div., Office of Federal Airways, CAA):* "In building one-runway airports, one of the problems that would arise involves the engineering of approaches. Speaking of conventional aircraft in the lighter wing-loading class, we have designs coming out with tricycle gear and wingtip tanks. With wingtip tanks on low-wing aircraft you have to give some thought to crosswind.

"Then there's the swept-wing airplane. Someone mentioned the crosswind gear on the B-52. The principal reason behind installation of the crosswind gear on that airplane is the fact that the swept-wing configuration can handle very little crosswind component . . . and we're going to have swept-wing configurations in high-speed aircraft of the future, whether they be military or commercial types.

"I don't know what the crosswind limitations are on delta-wing aircraft, but I've heard some strange things in conversation with British pilots who have flown them.

"Getting back to the type of crosswind we can handle, I think there always will be single-strip airports in parts of the country, and while we might be able to operate into those fields a major portion of the time, there would be times when such operations would be uncertain. A good example of that was at Washington National during Hurricane Hazel. Runway 9 has been closed for some time, but during Hazel the Connies and DC-6's came sliding down the ILS with a 40° crab, circled underneath the overcast and landed on Runway 9, turning off at the N/S runway. Of course, that isn't a normal operation, but if Runway 9 had not been available, it would have meant passing up that airport during that period of time. Any place where you have a crosswind component that is subject to extreme violence or turbulence from the surrounding terrain (the lees of buildings or hills), it's like flying up a gulch and is absolutely unpredictable."

J. H. Geisse: "It's quite true that the British did report trouble with crosswind operations with delta-wing aircraft, but pilots in this country who have flown delta-wings report there is no particular problem.

"The reason for the crosswind gear on B-52 is primarily because of its bicycle-type undercarriage. There is a tremendous load thrown on the outrigger wheels during a 25-mph or more crosswind because of the keel effect and lack of stability in that undercarriage.

"If ice is a problem in the decision to build single-runway airports, then one of the things that worries me, in view of the millions of dollars of taxpayers' money that is involved in the decision, is why someone hasn't gone out and made whatever tests are necessary to determine just how much of a problem ice really is.

"As far as my own experience is concerned—and it has been in an airplane with caster gear, I've landed on a runway so icy that the wheels didn't even caster. We just slid down the runway, but there was no problem in staying on it—and there was a heavy crosswind. The Canadians have a lot of that kind of operation and they reported they had no trouble with icy runways in crosswinds. The Air Force told me that practically all their northern airports are single-runway fields and they also reported no particular problem in icy conditions.

"Considering current airplanes, we never did intend that the private operator with a fixed-wheel undercarriage or standard gear should go in and land on these runways in a heavy crosswind. Our contention was that if he wanted to use these airports, he could have his airplane modified so

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Skyways Round Table

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that he could use them, and the cost to him would be but a fraction of the cost of putting in additional runways to take care of his airplane."

Nav-aid Interference

M. C. Ferguson: "Mr. Jenks, it has been suggested that if the Strato-Port screens are metallic they might affect the satisfactory operation of the electronic aids to air navigation. If that is true, extensive field tests would be necessary to predict the precise nature of the difficulties that might be encountered."

Arthur Jenks: "From my experience in flight-testing navigational aids prior to their permanent installation, and from review of the Strato-Port drawings, I can see no difficulty in precision approach aids. A terminal VOR or something of that sort might have to be located so that the antennas illuminate the wind screens uniformly, but that would be the only problem.

"As far as radar and the problems associated with it, it would be just the clutter problem that you would have with any site. A precision approach aid (ILS) is susceptible to interference if it is all on one side of the pattern. That is the trouble we have with a lot of airport installations—a single row of hangars or buildings where their reflections are unbalanced from the antenna's viewpoint. In other words, if the antenna illuminates two reflecting objects at the same angle and distance, one on either side of the course line, the reflections cancel and there is no problem."

Aid to Airports

Grove Webster (*Director of Aeronautics, Purdue Univ.*): "As the operator of one of the smallest airports in the country that has air-carrier operations, we're thoroughly confused. We have one runway that was built during the PWA days as a so-called experimental runway with 17 different types of surfaces in its 3500 feet. We also have another half strip which was experimental in the early 30's; its other half is nothing more than a grass field. Therefore, our NW/SE runway is half a runway, and our 3500-ft runway is NE/SW.

"Unless you have a 90% utilization of your airport, your volume of air-carrier operation in a city of our size goes down all out of proportion. In other words, unreliability of service quickly permeates the community and you lose utilization of your local-service airlines. Therefore, like others, we have long since had a master plan for our airport which is just gathering dust. That plan called for one 5,000-ft runway just off the E/W, and we also planned to maintain our S/W runway for the high-wind conditions we've been talking about.

"When this master plan was made, we had high hopes of the castering gear but apparently it has been shelved alongside of the master-plan runway.

"We have no money to build a $300,000 runway even if the CAA were willing to pay for half of it. We can't get $150,000 for a runway. We're doing the best we can. The CAA made a step backward in approving us to try to use the NW/SE runway when we couldn't use the other runway. So we're now using the grass runway for our air-carrier operations.

"We don't know where we're going from here, and you'll find a great many of the local service carrier airports in that same condition. If someone would come up with an answer, whether it be the Strato-Port or the castering gear, we might be able to pump a little life into these small airports.

"Because our airport is, in effect, a private airport belonging to the State of Indiana, we *might*, with the backing of the industry and the CAA, go directly to the State legislature for help in the construction of a one-runway field where we couldn't justify the establishment of more than one runway on our field."

Walt Pague: *"Let's now have some comments regarding the construction of a full-scale model of this one-runway idea, utilizing the Strato-Port concept. What would be its possibilities?"*

Operational Problems

William G. Benedetti (*Mgr. Flight Dept., Sprague Electric*): "I flew from carriers during World War II, and that experience leads me to believe that there might be a serious problem with the Strato-Port. Although I don't like to admit it, there were times during those carrier operations when I overshot the landing groove and got into what is known as the 'stack wash.' The only thing you could do was use every bit of available power and get out of there as quickly as possible. Now, with a strong crosswind component through this Strato-Port fence, I can see where you might have stack-wash and turbulence. How about the fellow making a low minimum approach, and suddenly running into this turbulence after he's all lined up on his ILS or the runway after breaking out of the overcast? I believe a full-scale model would be necessary to study this problem further."

M. C. Ferguson: "Turbulence would be a problem *if* you had a solid wall bordering the area. You'd have backwash which would be very bad. But a scientifically built screen can reduce wind velocity without creating any turbulence whatsoever. You can't reduce wind velocity by 100%, but wind-tunnel tests show that with a 50-ft screen you can reduce it some 90% and the flow of air that comes through the screen is completely parallel with the ground.

"Neither is there any turbulence above the fence. In fact, you have to go up another fence height before the wind resumes its original velocity. If you have a 50-ft fence, you'd have a height of 100 ft of reduced wind velocity and without any turbulence whatsoever.

"Wind-tunnel tests showed there is a direct relationship between the height of the fence and the distance between the fences. The tests showed that a 35-mph wind was reduced to 6.3 mph on the lee side of the fence; at the centerline in the runway area, it was 4.2 mph, and on the far side of the fence it was 3.9 mph. In other words, the wind was practically uniform all the way across, and any backwash that might come from buildings close to the runway would be screened through the Strato-Port fence the same as any other crosswind component."

J. O. Womack: "Wouldn't development or construction of a Strato-Port in a small town off-set putting in another runway?"

M. C. Ferguson: "Very definitely. Of course at this point we don't know too much about the cost. There again we are in a theoretical field, but we have some rather detailed estimates given to us by some competent people. Comparing the cost of the fences to the cost of an additional runway, the fences probably would not cost more than from ⅓ to ½ the cost of an additional runway. It certainly would be a considerable saving of money both in the elimination of additional runways and in the purchase of land required for the approach zones to such runways."

J. H. Geisse: "Mr. Webster indicated his problem was one of not being able to put in additional runways and not having caster gear available. I'm sure that if the industry had indicated any great interest, Goodyear would have made castering gear available for those aircraft, but not on a single airplane basis.

"Right now I'd also like to comment on the Goodyear gear because there are several stories about the Goodyear gear on Capital Airlines' Super DC-3's. One of the first stories that made the circuit was that the Super DC-3 with the caster gear was certificated for *less* crosswind than the standard DC-3. This was quite true, but it was due to the method the CAA has of certificating an aircraft: the Super DC-3 was certificated for the amount of wind that was available on the day of the test. Actually, that same gear has been certificated on both the CAA's DC-3 and on Goodyear's for a 40-mph crosswind component, and the CAA put out a press release stating that it would authorize the airlines to use the Goodyear crosswind gear on the DC-3 up to a 40-mph crosswind component.

"On this question of putting in a shorter cross-runway to take care of high adverse winds, there are a number of reasons why that might not be desirable. First, as soon as you introduce a cross runway, you have to find a site in which you have four clear approaches instead of two, all of which may limit your selection of sites and also cause you to select a site in which the clear approaches are not as safe as they would have been had you picked a single-runway field someplace else.

"My impression is that you're talking about having a main runway of 8,000 ft and a cross-runway of 4,000 ft. I think that if, instead of putting in that 4,000-ft cross runway, you added the 4,000 to the 8,000 and had a 12,000-ft single runway which would cost you less than the two runways, you'd have a safer operation because it would be available 100% of the time."

Walt Pague: *"Don't you think it would be more practical to parallel the runway?"*

J. H. Geisse: "That might be. However, something like 11% of all serious airline accidents are over-shoots. If you had your runway longer, there wouldn't be the overshoot hazard."

W. G. Benedetti: "Instead of lengthening the runway, why not widen it?"

J. D. Blatt: "With respect to the suggestion that we increase the width of the runways, there is a maximum width of runway that you can tolerate and still utilize

visual aids to air navigation. Once you ruin your gauge width, let's say runway lights were spaced 600 ft apart, you no longer get any center-line guidance from the airport lighting configuration.

"In this matter of the percentage of use we could get out of a single runway in this country, the CAA made a random study of 25 airports in the U. S. to determine what percentage of coverage you would get if there were only one runway at that location, using 15 mph as the allowable crosswind component. Of the 25 airports studied, the percentage coverage varied from 75.9% for Atlantic City to 100% at Durango, Colo., an indication that you cannot make a blanket statement that you can or cannot get coverage. It's completely dependent upon location.

"We also discussed here the fact that it would be better to have single strips at two airports than one airport with a multiple configuration. You cannot build two airports with single strips for the cost of building one multiple-runway airport. We estimate that a second runway increases the cost, that is, over a single strip, by 27%. It doesn't double the cost."

J. H. Geisse: "Mr. Blatt mentioned a 27% increase in cost for a second runway. I am familiar with the report from which he is quoting. The indicated saving was 27% of the *total* estimated cost of the airport, including a number of items having nothing whatsoever to do with the runways. The second runway increases the cost of the landing area by appreciably more than 27%.

"A study was made not long ago by the CAA of one particular airline that used something like six single-runway airports. Their actual loss in revenue throughout a year was something like $700. Assuming that business would fall off because the airline wasn't as regular as it could be, CAA estimated their loss would be around $50,000 a year. Then they estimated the cost of putting in an additional runway at these airports as somewhere around $500,000. Naturally, the estimated loss did not justify the second runway. The fact that wasn't mentioned and that impressed me, however, was that for $50,000 that particular airline could have modified every one of its DC-3's to operate from the single-runway airports without any schedule delays."

Walt Pague: *"I'd like to ask now whether or not the panel would be in accord with the idea of constructing a full-scale Strato-Port."*

Strato-Port Costs

Grove Webster: "I have an open mind on the subject, but what disturbs me is the statement that the construction of an experimental Strato-Port would cost from ⅓ to ½ of what an additional runway would cost. If that is so, I'd seriously question an experimental construction of a Strato-Port. That seems like a lot. Perhaps we should have more knowledge of the actual cost of such an experimental unit in relation to the cost of another runway. If in the final construction of the 3500-ft runway, the added cost of putting up the screens would approach ⅓ of the final cost of the runway, then I'd question the whole project."

(*Continued on page* 36)

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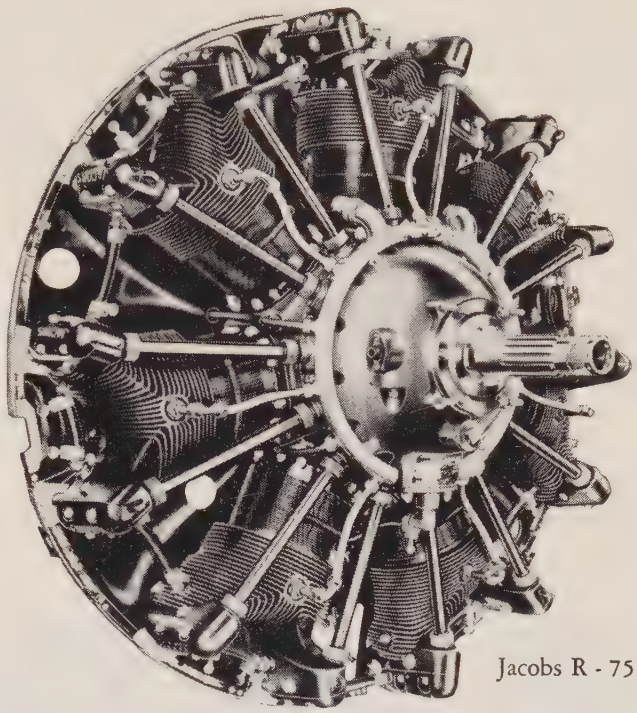

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Skyways Round Table

(*Continued from page 35*)

J. D. Blatt: "I'm wondering why you arrive at that conclusion. Let's assume the full-scale Strato-Port would save a considerable amount of expensive land in addition to whatever runways and taxiways might be required, why would that be excessive in your mind?"

Grove Webster: "If you're thinking of a completely new installation, that's one thing, but from now on, how many airports are going to be constructed from the ground up? I'm thinking of it in relation to the situation at my own airport. If the screen were to cost $30,000 or $50,000, it would be one thing, but if it goes over $100,000 and the runway costs $300,000, then you begin to question the advisability of it. Now I'm basing this $100,000 possibility on the ⅓ to ½ figure that was given."

W. G. Benedetti: "I agree with Mr. Webster that the ⅓ to ½ figure sounds like a lot of money when you're talking upwards of $100,000. However, I also feel that inasmuch as so much time and effort have been devoted to the Strato-Port project, an excessive amount of money would not be involved in building an experimental Strato-Port on a small scale, not a 10,000-ft runway, but perhaps a 2,000-ft one, using a lightplane for the test. Then we could tell whether or not the idea would work."

Grove Webster: "I'm all for a study to find out whether or not the Strato-Port idea will work. At the same time, however, I'd like to see the whole thing tied into a re-evaluation of the castering gear. Then when you're all through, you'll have the answers to both ideas."

M. C. Ferguson: "One of the reasons the crosswind gear has not been adopted thus far is the additional weight it involved. Our thought in attacking the crosswind itself—or in trying to control it—has been that it would enable you to leave your crosswind gear on the ground, so to speak, and not have to lug it around with you, particularly when you don't need it all the time.

"If this project of ours, either standing by itself or supplementing the work already done on the crosswind gear, saves lives or aircraft, it would soon be paid for. We feel we have gone as far as we can go on a small scale. We now have to go full scale to find the rest of the answers."

Summary

Walt Pague: "*Apparently, gentlemen, we're in at least partial agreement that the single-runway or the Strato-Port concept may be the answer to the problem of constructing airports in communities that do not have them.*

"*In order that we may come to some conclusion on this subject of making the single or parallel-runway design the standard pattern of airport configuration, I think we might summarize our discussion this way:*

1. The single or parallel-runway configuration is fast becoming a necessity, both from the standpoint of safety and economics and as a basis for future expansion.

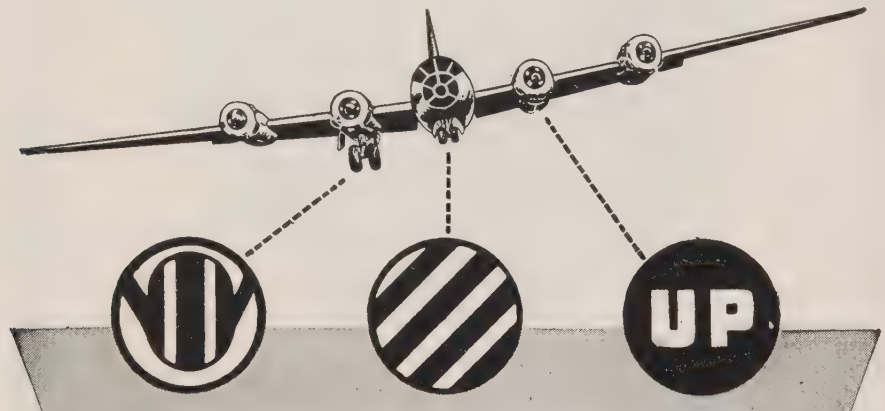
2. The single or parallel-runway airport has one shortcoming, namely, difficulty of operation in strong crosswinds.

3. Crosswind landing gear has been developed to a degree where it is considered technically acceptable for aircraft, but because of the additional cost and weight factors involved, it is not yet generally acceptable for airlines, business aircraft or personal airplane operations.

4. The only way to operate on a single or parallel-runway airport under severe crosswind conditions apparently would be to screen the runway or runways from such crosswind components, as is contemplated by the Strato-Port project.

5. From the Staff Study which the CAA has made of the Strato-Port concept and from the opinions expressed on this subject by Messrs. Blatt and Jenks and some of you other gentlemen on this Panel, it seems quite clear that the decision of the NBAA to support the need for a full-scale test and evaluation of the Strato-Port, to determine the practicability of its design features and its potential value in meeting the growing airport dilemma around the nation, is fully justified.

"*Before I declare this Panel discussion adjourned, however, I want to thank all of you gentlemen for your interesting participation and, as a member of the Board of Directors of NBAA and your Moderator today, I want to express to the Editorial Staff of SKYWAYS our sincere thanks and appreciation for making possible this interesting and important contribution to our NBAA National Convention.*" +++



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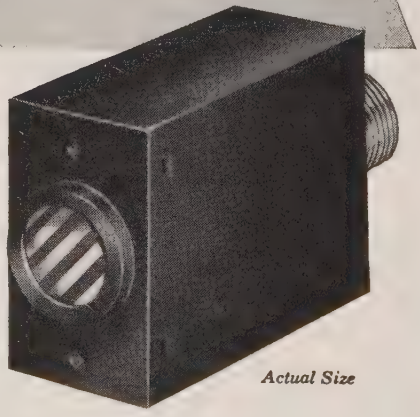

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Airborne Radar

(*Continued from page* 10)

der the bases and IFR penetration through storm clouds, the maximum acceleration recorded on the Ryan recorder during a flight prior to the time the NACA recorder was operative was 1.3g, which was equivalent to 1.14g on the NACA.

Of the 582 subjective observations logged by the weather observer at intervals of 5 to 10 minutes during the tests, 94% indicated smooth or slightly rough air. Only 5.7% were logged as moderately rough and 0.3% as rough.

From the NACA gust data, we found that the maximum derived gust velocities encountered during the 35 hours the NACA recorder was in operation were —33.7, —25.2, and +23.9 ft/sec, and the accelerations associated with these gusts were —.97, —.67, and +.78g respectively.

While a detailed analysis of the NACA gust data has not been made, the gust values were tabulated in one ft/sec brackets with the following results:

Gust Velocity Ft/Sec	No. of Gusts Encountered
11-11	281
11-12	160
12-13	101
13-14	50
14-15	54
15-16	28
16-17	25
17-18	13
18-19	11
19-20	6
20-21	4
21-22	2
23-24	1
25-26	1
33-34	1

For the most part, the 35 hours of recordings via the NACA recorder were taken while in the immediate vicinity of thunderstorms. Some flights were made in storm areas where considerable turbulence could be expected, just to confirm radar indications. Our gust experience is, therefore, higher than would probably be expected for passenger operations where turbulent areas would be given as wide a berth as practical.

Prior to the United Airlines evaluation program, attempts to detect hail were completely unsuccessful. Therefore, the conclusion "It provides a satisfactory warning of hail shafts" is very significant. Out of 31 thunderstorm flights, 23 encountered hail, saw it, or received ground reports of it and no other radar project has ever collected a more comprehensive set of hail pictures. Out of the catalogue of hundreds of pictures, 84 were selected for study in detail as representative examples. Of those 84 echoes, a finger or a hook or both were present in 82.

Comparisons with Other Radars

The United evaluation team was interested in comparing our 5.5-cm radar with other radars operating on shorter and longer wavelengths and we were fortunate in being able to make three comparisons; the first with a Weather Bureau 10-cm ground radar, the second with a military airborne APS-42 3.2-cm radar, and the third with an Air Defense Command radar. Since only a single flight was conducted with each type, comparisons were not conclusive, but each turned up information of interest.

At North Platte, one member of the group stayed on the ground to watch the Weather Bureau 10-cm scope while "Sir Echo" flew overhead, around and through the thunderstorms in the area. The radar echoes as seen by "Sir Echo" were closely confirmed by the Weather Bureau. These echoes were masked from visual observation by the nearly solid more than 100-mile bank of clouds lying southeast of North Platte.

Another ground comparison was made with an Air Defense radar. During this comparison, two members of the evaluation team stayed on the ground to view the Air Defense scope and sketch echoes while "Sir Echo" flew overhead. The echoes on the two scopes are nearly identical, although United actually painted more detail than Air Defense, but this was to be expected because it was closer to the precipitation. No opportunity was afforded to study the Air Defense scope displays of distant precipitation echoes.

Observations of weather echoes on the ground radarscopes lead us to conclude that while these radars would show severe storms at distances of 100 miles or more, the resolution with their larger antennas is not sufficient to permit ground operators to vector aircraft through narrow corridors between storms when the storms are more than 40 or 50 miles distant. Air Defense controllers confirmed this thinking by informing us that their vectoring service consisted of steering pilots around storms and storm lines and not through them. Thus, we may conclude that ground radar is primarily an effective tool for giving pilots the broad picture but does not provide sufficient detail, particularly on distant echoes, to permit them to be steered through narrow corridors in lines or clusters of thunderstorms. Obviously, Airport Surveillance Radars and other ground radars can be used at short ranges for vectoring aircraft through corridors but it is impractical from an economic point of view to locate ground radars close enough to provide corridor vectoring service along all airways. A very complicated communications problem would also be presented by such a system for avoiding thunderstorm turbulence.

Our third comparison was with an APS-42 3-cm radar installed in a Navy R5D. The most amazing thing about this comparison flight was the weather itself. Unscheduled and unpremeditated, this follow-the-leader flight was set up on the morning of August 9, when there wasn't a cloud in the sky within 300 miles of Denver. That afternoon within an hour's flying of Denver, an 8-inch cloudburst occurred between Flagler and Burlington which put the Rock Island Railroad tracks under water, washed out highway bridges and inundated whole ranching communities. Hail fell in several spots. The longest line of storms brought within view of our scope during the whole summer season was seen that afternoon; a line 140 miles long.

From a study of the many comparative 5.5- and 3.2-cm radar pictures taken, it was apparent that:

(1) 3.2-cm radar overpaints precipitation

(*Continued on page* 38)

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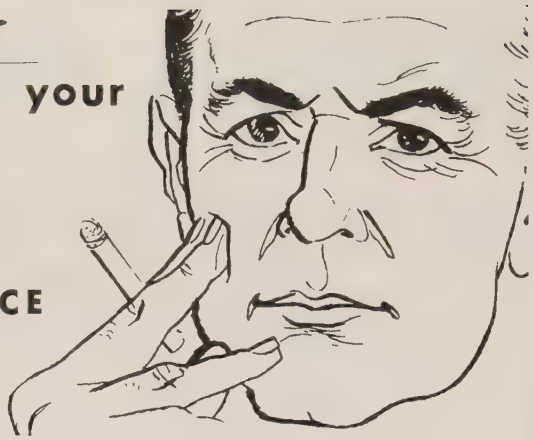

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Airborne Radar

(*Continued from page 37*)

and shows strong echoes where 5.5-cm paints only harmless fuzz which, from experience, we had found could be flown through with no difficulty.

(2) Many 3.2-cm echoes were being attenuated on the back sides. This characteristic was supported not only by earlier 3.2-cm observations made by American Airlines and the Navy, but also by simultaneous 3.2- and 10-cm ground observations made by Mr. Hal Foster of MIT.

I am convinced from our experience as well as the experience of others that if you do not want to be misled by airborne radar weather indications, you had better use a wavelength of 5.5 cm rather than 3.2 cm. Of course, if you plan to avoid *all* storms by flying around them, 3.2 cm will help you do that.

5.5-cm Commercial Radar

While the description of a commercial airborne radar system could be provided by reading the details of the Airline Electronic Engineering Committee's 5.5-cm Weather Penetration Airborne Radar Characteristic, I will instead describe the system being built by RCA to meet these characteristics. A quite similar system which will be interchangeable electrically and mechanically but operating on a 3.2-cm wavelength, is being built by Bendix Radio Corporation. It is understood that Bendix also contemplates building a 5.5-cm version as well. I have selected the RCA system because it is the only 5.5-cm system presently in operation and I believe a 5.5-cm radar is required for airborne weather radar operations.

The RCA system is made up of five major units for a single-scope installation (six units in a two-scope installation). Total weight of the components is approximately 113 pounds with installed weight estimates running from 150 to 200 pounds (which, incidentally, does not include weight of additional or larger inverters if they are necessary to provide the AC power). The equipment requires approximately 1,000 watts of AC power and 30 watts of DC; 600 VA of the AC power must be 115 volts +/—5%, 380 to 420 cycles and the remainder 400 VA may be 115 volt +/— 10%, 300 to 1,000 cycles.

The antenna with a 22-inch parabolic dish which will give a 7° beam width weighs 24 pounds. A 22-inch x 30-inch elliptical dish can also be used with this antenna mount to give a 5.4° horizontal beamwidth. The antenna is stabilized in roll and pitch, will rotate through 360° at 15 rpm and can be tilted up 10° and down 15°. Gyro signals from an autopilot may be used for antenna stabilization. A maximum of 30 feet of waveguide may be used between the antenna and the transmitter-receiver units.

The Transmitter-Receiver and Accessory Units weigh 43 and 32 pounds respectively. Each unit is 10⅛ inches wide, 19-9/16 inches long and 7⅝ inches high, and all connections, including waveguide, are made through connectors at the rear of the units. These units are self cooling, although apertures are provided for use in aircraft which will use forced air cooling. Since most of the 1,000 watts of power consumed by the radar is dissipated in these two units, it is anticipated that the installation of these units in the radio rack will require the use of forced cooling in most aircraft installations.

The Indicator Scope weighs 13 pounds and is approximately 6¼ inches square by 13½ inches long and uses a standard 5-inch 5FP7A cathode ray tube. The RCA version is provided with Focus, Intensity, Height and Cursor controls and the display is a centered PPI type. I envision the production indicator we expect to install will use an

FIGURE 9

off-centered PPI display to make better use of the scope area, possibly with fixed lines radiating from the aircraft's position on the scope.

Controls have been simplified as much as possible. The panel is only 3⅜ inches x 5¾ inches x 4½ inches and carries Function, (ISO-Echo) Contour and Stabilization switches, plus Tilt and Gain controls.

Indicator Scope

Illumination of existing type cathode ray tubes is adequate for operation in the cockpit without a hood only during night conditions. During daylight operations a hood is required in order to permit the observer's eyes to become adjusted to the low light intensities presented on the scope. In view of this fact and until the bright storage display tube becomes available, the scope should be located beside the pilot's seat so that it may be used with a hood and viewed with the pilot's eyes not more than 18 to 20 inches from the scope face. One bright storage-type display located in the center of the instrument panel will probably be adequate for both pilot and copilot. Until the bright display becomes available, we plan a separate scope for pilot and copilot use.

It is my belief that it is the characteristics of the present-type scope tube that call for almost continuous pilot attention while flying through thunderstorm corridors. A bright storage tube should reduce the attention required. It is the general feeling of those who participated in the United evaluation program that when actually engaged in the process of penetrating a line of storms, particularly through narrow corridors, one crew member should devote most or all of his time to observing the scope, directing the other crew member where to fly. If an autopilot is being used, the pilot doing the radar observing can also fly the airplane.

Since most storm lines are not very wide when penetrated perpendicularly, the period of time during which one crew member would be devoting most of his time to the radar would be limited and, therefore, we do not envision any need for a third crew member to maintain the radar watch. Normally, the corridors between storm cores are quite wide, in which case very close attention to the scope is not necessary. This point of view, incidentally, applies to the use of either the present type display or the future bright tube display.

Summary

In outlining the United evaluation program and its results and conclusions, the operational applications of airborne radar have been covered. In order that they will stand out better, let me summarize them for you by answering the question "What exactly can the pilot do with radar that he hasn't been able to do before?"

1. He can detour a *storm* area after having scanned it from 75 or more miles away, thus giving him the opportunity to instigate a detour at a point where his flight time will be increased very little.

2. He can *choose* a corridor of the mildest activity or turbulence if penetration of a storm area is desirable or necessary (*Fig. 9*). Normally, a suitable corridor can be found without departing more than 5 miles from the planned flight path.

3. He can scan the *area* around an air-

(*Continued on page 40*)

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Airborne Radar

(*Continued from page* 39)

port, before taking off or landing, to determine the best possible flight path out of or into that airport.

4. He can establish his position relative to high terrain or easily distinguishable ground features.

5. He can give valuable *information* to other aircraft not equipped with radar, thus reducing operational delays during storm seasons.

I feel that the ability of airborne radar to do these five things and in so doing avoid damaging hail and provide the passenger with a relatively smooth ride through thunderstorm conditions, justifies the installation of airborne radar in airline aircraft, particularly when we consider the amount of thunderstorm activity confronted every year.

In weighing the costs of an airborne-radar installation in an airline fleet, tangible and intangible savings must be considered. Tangible savings include: 1) shorter detours and shorter periods of reduced speed in thunderstorm areas; 2) less holding; 3) fewer static discharges (lightning strikes); 4) less hail damage; 5) probable elimination of structural damage resulting from thunderstorm turbulence.

United's conservative evaluation of these savings indicate they would pay off installation plus maintenance costs of a fleet radar installation in 10 to 12 years.

In addition to the tangible savings, there are the following non-measurable or intangible savings which will reduce the 10-to-12 year amortization period considerably: 1) customer good will; 2) improved standing in comparison with carriers not equipped with radar; 3) reduced missed customer connections; 4) cancelled flights (with loss of revenue); 5) disruption of operations, including off-line operation and stops, ferrying, added passenger-handling costs, etc.

I trust that this has not given you the mistaken idea that radar is either an infallible crystal ball or a complete answer to the avoidance of all turbulence, for we have only scratched the surface in our radar evaluation. I believe, however, that conservative operating procedures using airborne radar within its limitations will not only contribute tremendously to increased safety, passenger comfort, and schedule reliability, but will also provide the flight crews with a new "tranquility of spirit" when those thunderclouds loom up ahead. Civil airborne radar is here, bringing CAVU weather to the cockpit.

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Synthetic Oils

(*Continued from page* 12)

not attractive for aircraft-turbine lubrication because freezing points are relatively high and slopes of viscosity-temperature curves for some are not very attractive. There are a few exceptions on which further study appears justified, such as monoesters of pelargonic acids.

The aliphatic diesters, made from dibasic acids, appear at present to be the most promising of not only all esters but of all synthetic lubricants. These diesters are outstanding with respect to excellent viscosity-temperature characteristics, high thermal stability, low volatility and wear prevention *(Table I)*. They also are generally non-corrosive to metals, stable to hydrolysis, relatively non-toxic and similar to or slightly less flammable than mineral oils.

Two disadvantages are present; first, higher cost and second, higher rubber swell. These disadvantages, however, have not proved to be serious with respect to their use in the aircraft turbine. The raw materials used in the manufacture of diesters come from many different sources such as petroleum, animal fats, vegetable oils, sugar, turpentine, etc.

Triesters, tetraesters and other polyesters show considerable promise as high viscosity blending agents. Most of these are too high in viscosity and freezing points to be used as unblended oils in the aircraft turbine. Some of these polyesters also exhibit remarkable thermal stability.

Most Promising Synthetic Oils

Of the thousands of synthetic oils examined for possible use in the aircraft turbine, two types appear the most promising.

a. Aliphatic diester

b. Polyglycol (doubly chain-stoppered)

The pertinent characteristics of finished oils falling in these two classifications as compared with a mineral oil are shown

TABLE II

COMPARISON BETWEEN MINERAL OIL AND EXPERIMENTAL POLYGLYCOL AND DIESTER OILS WITH VISCOSITIES @ —65°F. BETWEEN 8,000 AND 10,000 CS.

	Mineral Oil Blend Grades 1005 + 1010	Polygylcol Oil (With additives)	Diester Oil (With additives)
Viscosity cs.,			
@ —65° F.	8380	10,300	8710
100	7.42	10.65	12.77
210	2.05	3.19	3.35
Flash Point, ° F.	260	360	425
Evaporation, %			
22 hrs. at 275° F.	56.2	——	0.73
6½ hrs. at 400° F.	97.0	31	8.0
Panel Coking, 8 hrs. at 600° F., mg.	387	N. A.	63
Ryder Gear Scuff, PPI (Average of two tests)	650	N. A.	2130

N. A.—Not available.

n *Table II*. In selecting oils for this comparison the viscosity at —65° F. was narrowed down to the range of 8,000-10,000 cs. For the mineral oil a blend of grades 1005 and 1010 (MIL-O-6181A) was prepared with a —65° F. viscosity of 8380 cs.

Of the three oils shown, the diester appears to be the first choice with respect to viscosity-temperature characteristics, evaporation (volatility), Panel Coking (high temperature stability), and Ryder Gear Scuff values.

While the full possibilities of the polyglycol oils have not been fully realized, they seem to rate second to the diester. Where low-temperature starting requirements are not as severe, the polyglycols are more attractive especially if cost is a factor in the selection.

High-Temperature Bearing Test

With the possible exception of a full-scale engine test one of the most valuable lubricant tests is the high-temperature bearing test. Such a "bench test" can establish high-temperature stability, volatility, ability to lubricate a bearing, tendency to form deposits and compatibility with certain metals.

These high-temperature bearing tests were devised originally to investigate metallurgy, bearing design, design of housings and seals. However, since many of these bearing test rigs have correlated so well with the full-scale turbine, they are proving equally useful for investigation of lubrication problems.

One of the outstanding bearing test machines used for testing synthetic oils is the Napier rig. This test method now is a requirement in the British Ministry of Supply Specification No. DEngRD 2487, Synthetic Type of Aircraft Turbine Engine Lubricating Oil. This rig employs two-inch I.D. ball bearings operating at 21,000 rpm and 280° C. (536° F.), test cycle covers 45 min. from ambient to 280° C. and 6½ hrs. at 280° C. Oil flow through each bearing 3 pt./hr.

Note: The above test cycle is repeated until significant deposit is formed to interfere with bearing operation, or until the bearing shows signs of failure.

DN values (Bore dia. mm. x rpm) of the Napier Bearing Test are over 1,000,000, representing conditions typical of recent turbine design practice.

Wright Aeronautical also has found their high-temperature bearing test rig to be very worthwhile for investigation of bearing and lubrication problems. This machine also operates at DN values in excess of 1,000,000. Unlike the Napier rig that uses a solid oil jet and recirculation, the Wright rig has a metered oil flow corresponding to the type of oil system in one of the bearings of a current model of turbine. Test conditions are: bearing size 127 mm bore, speed 8300 rpm, outer race temperature 700° F., oil flow ½ lb./hr. (single bearing) and 7 hrs. maximum duration.

Panel Coking Test

One of the significant oil tests carried over from the piston engine to the turbine field is the Panel Coking Test. This method was devised originally by the California Research Corporation. In its original form it was used to determine tendencies of piston engine oils to produce rocker box coking. Pratt & Whitney Aircraft subsequently made some modifications in the method and found it well suited to determine high-temperature stability of turbine lubricants. It is now an established test method in the U. S. Military Specification MIL-L-7808.

This method employs an inclined aluminum test panel held at 600° F. The test

TABLE III

Comparison of Ryder Gear Test Values for Mineral and Synthetic Types of Aircraft Engine Oils

	Oil	Ryder Scuff Test	
	Viscosity CS. @ 100° F.	No. Tests	Average Value P.P.I.
Mineral Oils			
Blend-Grades 1005 and 1010	7.42	2	650
Grade 1065	114.7	4	1240
Grade 1100	249.3	6	1950
Synthetic Oils			
Diester Base Oil	14.2	2	1030
MIL-L-7808 Type (with additives)	12.77	2	2130
D Eng RD 2487 Type (with additives)	38.0	2	2490

(*Continued on page 46*)

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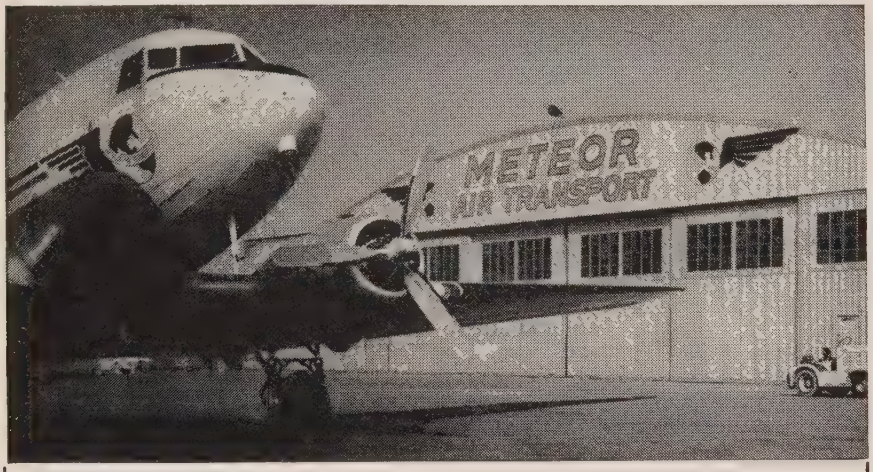

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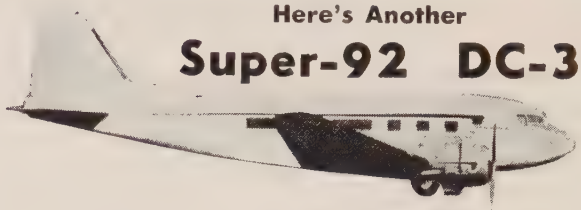

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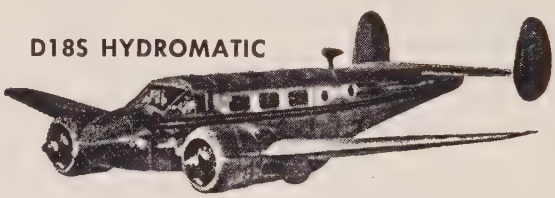

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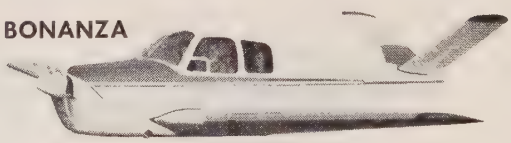

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Continued from page 43

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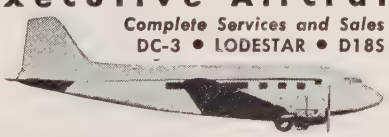

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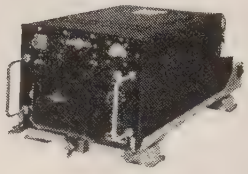

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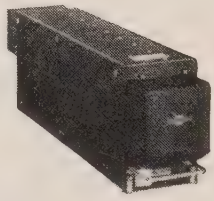

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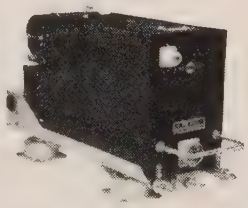

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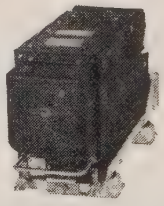

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Synthetic Oils

(*Continued from page* 41)

oil is carried in a bath below the test panel and a motor driven rotary brush splashes oil against the underside of the panel.

The temperature of the test panel is held at 600° F. for a period of 8 hours. The present limit allowed is 100 mg. A comparison between the values obtained with various synthetic and mineral oils appears in *Figure 7.*

This is strictly a quantitative test and measures only the amount of deposit adhering to the panel. It does not indicate whether the deposit is comparatively harmless to bearings or whether of a gritty abrasive nature.

Ryder Gear and Lubricant Test

Two methods are currently used for testing the ability of synthetic oils to lubricate gears; first is the I.A.E. Machine used in Great Britain and second, the Ryder Gear and Lubricant Tester employed in the United States. Both test machines are somewhat similar in general arrangement although the latter operates at much higher speeds.

Of the countless number of so-called E.P. bench tests, none thus far have shown any satisfactory correlation with full-scale engines. Their acceptance, therefore, in the field of synthetic lubricants is extremely limited. Certainly the results obtained from such E.P. test machines cannot be applied directly to design of the aircraft gas turbine.

The original Ryder Machine was built in 1941 for the purpose of testing gear materials and lubricants for the piston engine. Unlike so many E.P. bench tests, the Ryder Machine used actual gears from typical engines as test specimens. After making some improvements, Pratt & Whitney Aircraft found it to be quite useful for piston-engine reduction gear problems.

The present Ryder Machine used for testing synthetic lubricants consists of a hydraulically loaded "Four Square" rig. The test gears are mounted on two parallel shafts, one driven by the other through helical gears. The axial load on each shaft is created by hydraulic pressure on each piston and helical gear. Loads on the test gears then are directly related to hydraulic pressure.

The present method calls for operation at 10,000 rpm or a pitch line speed of 9,160 fpm. Each test employs a new set of gears (or new face).

The test procedure consists of a series of 10-minute runs with an inspection of gear teeth after each run until 22½% of the tooth area has been scuffed.

A comparison of Ryder Gear Test values for various aircraft engine and turbine lubricants is shown in *Table III.*

Although the Ryder machine is one of the best of the available methods, more experience is needed to determine its reproducibility, correlation and significance to full-scale engine results.

Summary

An aircraft turbine lubricant must fulfill three important requirements: 1) be low enough in viscosity at the starting tempera-

(*Continued on page* 48)

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Airport Qualification

(*Continued from page* 7)

tive to the airport. Notice how this approach is unobstructed and that you have almost three miles of open water to the threshold of the runway.

"Your instrument landing straight-in minimums for Runway 22 are 500 ft and a mile and a half. Incidentally, Runway 22 is utilized in conjunction with Runway 13 as a preferential runway for landings. Runways 31 and 4 follow them in that order. Remember that Runway 18-36 is no longer used except for parking airplanes.

"From the New York skyline, you can see why our initial instrument approach altitude over or from that area is 2400 ft. Please direct your attention now to the sea wall dike that is 218 ft from the runway threshold. The top of the dike is 15 ft above mean sea level but only 6 ft above the runway. Both the dike and threshold are lighted. Note the dashed center line down the runway and also the parallel lines indicating your relative position along the runway. Remember that this runway has a very definite gradient slope of one-quarter of one percent, starting approximately halfway up the runway. This means that the far end of the runway is 12 ft higher than the lower half.

"The next approach is to Runway 31. The length of the runway is 5900 ft and the threshold is 7 ft above sea level. The turning point for Runway 31 is the three-story factory, which permits a normal turn around it to put you into direct alignment with the runway. Note the Flushing tank, which is 337 ft high. Your minimum circling altitude is 800 ft. However, for noise abatement purposes, 1400 ft can be maintained under good VFR conditions until you begin your turn into final approach. Upon completion of this turn, you can see the Flushing shoreline lying alongside at your right. Notice that the approach from this position is over water and unobstructed. There are no radio aids on this runway and your approach must be based on local, visual reference points only.

"As we approach, refer momentarily to your airport chart again for your own orientation as we continue on a heading of 310°. The dike preceding 31 is 5 ft higher than the runway, but it is 144 ft from the threshold. Notice the 200-ft width of the runway and its various painted markings, consisting of the threshold 8-bar lines, the dashed center line, the broken line painted across the runway at the one-quarter length distance, and the solid line across the halfway mark.

"As we level off over the runway and continue on as in take-off procedure from Runway 31, note the five stacks ahead and slightly to the right. They are 300 ft high. A right turn approved by the tower will enable you to avoid congested Bronx areas and permit you to climb over water, again assisting in the noise abatement program.

"We are approaching Runway 31 again and you can see how under certain conditions sunlight might prove to be hazardous to your approach (sunlight reflecting from water) unless you are prepared for it. On calm days, this mirror effect is even more pronounced.

"We are now making another approach to Runway 31, utilizing the five stacks. This would be normal operation when you approach LaGuardia from the southwest. The visual turning point for both left- and right-turn approaches into Runway 13 is the factory with the five stacks that are 300 ft high. Your circling minimums again are 800 ft, giving you a cushion of 500 ft over the stacks, but you should hold 1400 ft until turning onto final if conditions allow it. You will see that Riker's Isand provides a good visual reference point by keeping it on your left as you close into Runway 31. This view approaching the threshold of Runway 13 again provides an opportunity to refer to your chart to see the relative positions of hangars, control tower and other physical features of the airport."

That is a portion of a typical commentary on the sound track of a typical Cinemascope color film prepared by Pan Am for pilot airport qualification. It applies in this case to LaGuardia, but other film can be used for pilot qualification into any other regular, provisional, alternate or refueling airport in the world. And it has this one big advantage over the present "visual reference" system: It will far exceed the training and familiarization currrently obtained by flying pilots to provisional or refueling airports once a year to the minimum degree accepted by Civil Aeronautics Adm.

The reception of the LaGuardia film wherever we have shown it has been, in a word, enthusiastic. It has won acceptance for its promise of providing perhaps the best answer to the problem of what standards to apply to route and airport qualification for air-carrier operations.

Interest also has been shown in our film procedures by the U. S. Air Force, which uses many "strange" air fields in the deployment of its tactical units. It is believed that the use of the Cinemascope film system as an Air Force training aid would have many definite benefits, particularly in the realm of safety.

The system of provisional, refueling and alternate airports, which must be available at those times when regular airports, normally the destination of scheduled flights, are forecast to be closed, will always be an essential part of air-carrier operations. And the flight operational burden of qualifying pilots into such airports will always be a responsibility of the air carriers.

We believe that the wide-screen color projection, when properly prepared and used, will simplify the qualifications of pilots into airports essential to on-time schedule airline operations, save time, reduce costs and increase safety.

Synthetic Oils

(*Continued from page* 46)

ture to permit oil to flow to the pump; 2) remain stable at highest temperature; and 3) lubricate highly loaded gears.

At present, U. S. Military operations require that aircraft turbines start at —65° F. while British specify —40° F. At each of these temperatures it has been found that a kinematic viscosity somewhere between 3,000 and 10,000 centistokes is required.

Maximum operating bearing temperature is approaching 500° F. in a number of recent aircraft turbines. The temperature rise following shutdown or "soak-back" may add another 100 to 150° F. to the operating temperature. A lubricant, therefore, must withstand these conditions without excessive evaporation or the formation of harmful deposits.

A synthetic lubricant in addition to meeting the requirements of both extremely low and high temperatures must carry about the same gear loads as the high-viscosity aircraft engine oil, Grade 1100.

In a majority of turbojet engines already in service, mineral oils have given good results over the temperature range from —65° F. to +300° F. For some of the newest models of turbojets synthetic oils are required for the temperature range of —65° F. to +500° F. To what extent the bearing temperatures will be permitted to rise in future engines cannot be predicted at present.

Although the gear test rigs show that synthetic oils are equivalent to Grade 1100 mineral oils, much more experience in full-scale turboprop engines is required to confirm this point.

Undoubtedly in the next few years other new and interesting synthetic oils will be prepared and certainly the knowledge covering the performance of present oils in turbines will grow rapidly.

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